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THE ELECTRIC MOTOR IN SALVAGE WORK.

An interesting application of the electric motor in salvage work is noted in a brief description of the work now being done at Port Arthur on the damaged Russian warships. The work on the Bayan was in charge of Captain Sakamoto and Engineer Captain Takakura. These gentlemen found at Dalny, in the electric power station there, a dynamo, and they secured an engine and boiler and set these up on shore in a temporary house near the vessel. They secured also at Dalny a motor-driven centrifugal pump which had been sent on there for work on the new drydock, but had never been installed. This motor was put to work in pumping out the Bayan, in which service it did excellent work. A second motor-driven centrifugal pump was found on one of the hills at Port Arthur, which was also appropriated and put to work. By means of these pumps, as well as those on the vessel herself, all the work required was accomplished.

PHYSICS EXTRAORDINARY.

The accomplishments of physical science are truly wonderful. While, perhaps, not appealing as strongly to the lay mind as does the work of the engineer, they must nevertheless be counted among the greatest achievements of our civilization. One striking illustration of the marvelous potency of scientific methods is the addition to our knowledge of the nature of things which has been gained through the study of radium.

The phenomenon of radioactivity has been known only ten years, and was entirely new when discovered. It seemed utterly opposed to our previous conceptions of matter, yet in ten years we have made such progress that we now feel that we know vastly more about the molecule than we had any hopes of learning for a long time before the discovery of radioactivity. And that is not all, for ten years ago we had no basis for believing that an atom could be broken up, while now we seem to know more about the constituent parts of the atom than we previously knew of the atom itself. We have not only shown that an atom can be broken up, but we have shown that, in certain cases, this disintegrating process is exceedingly complex and takes place in successive stages, one following the other. Uranium, for example, which is supposed to be the parent element of radium, first breaks up, forming uranium X, which then changes to radium. Radium then gives off the so-called emanation, and this, in various ways, goes through six stages, finally reaching the form known as radium F. As yet no further change has been traced, but Professor Rutherford, who has been particularly instrumental in this remarkable work, thinks that it is probable that finally lead is formed, since this material is always found associated with radium ores in quantities suggesting the inference.

Besides this determination of the stages of decomposition of the radioactive materials, the character of these changes has been determined; in fact, it is from the peculiarities of the latter that the various stages have been recognized. During certain of the changes, particles of charged matter—if we may still use this term—are thrown off at terrific velocities, and produce disastrous effects upon any other material which may lie in their way; in fact, these minute projectiles actually shatter to pieces molecules of matter which they encounter.

Naturally, the laws governing the movement of these atomic fragments would be of the greatest interest to science, and it is with a sense of gratification that one learns that recent researches seem to indicate that they are neither more nor less than the laws of motion enunciated by Newton for terrestrial matter, and later extended to the visible universe.

Truly, these developments of physical science are of the greatest importance, and it is worthy of remark that they have been accomplished by the means of simple apparatus, though,

of course, constructed in a refined way. With mathematics as his dark lantern, and a simple electrical instrument as a jimmy, the scientific burglar is rapidly depriving Nature of some of her most cherished secrets. Fortunately for the pleasure of the burglar, the further he penetrates into Nature's treasure house, the larger does he find it to be, and the richer the treasure.

IMPROVING TRAFFIC CONDITIONS IN LONDON.

London, the largest city in the world, is one of the last to take up its traffic problems seriously, and devise plans for improvement. While a certain amount of traffic regulation has been enforced for a long time past, no amount of regulation will correct the evil of narrow and crooked streets. The condition was at last seen in its true light, and a traffic commission was appointed to go over the entire situation and draw up plans for improving it. The report of the commission is now being prepared, and is very voluminous. It is contained in eight volumes. One of these—vol. vii—has just been issued and is of much interest to us in this country. This is the report made to the commission by its advisory board of engineers.

One sentence from this report may be quoted with profit. It is as follows: "The prime cause of London's backwardness is to be found in the lack of homogeneity in its municipal system, and an entire absence of any centralized control and of consequent guiding effort which such control ensures."

Fortunately for the cities of this country, this phase of the traffic problem has not been so serious. We, with our love of bigness, consolidate adjoining towns, and allow a large city to absorb villages and towns on its outskirts. Doubtless, this method of growth has some—probably many—disadvantages, but it certainly simplifies the traffic problem and aids toward better service. Yet we have found that this is not sufficient. Some general plan of development must be adopted, and adhered to, if our cities are to develop in the best way. If this is not done, sooner or later they will be confronted with intolerable conditions which can only be changed at great expense and much discomfort to the community. Certain of our larger cities have already adopted plans for guiding future growth, and are studying, with great care, the traffic requirements of the cities as they now are and as they are expected to be. Those towns which have not taken this step can not do so too soon. Well-considered plans, adopted to-day, will save taxpayers much money in the future.

Another phase of the London traffic report which interests us in this country is that referring to the regulation of the traffic on the streets. In the central part of London the streets are so narrow that there is room for only two lines of traffic in each direction, which is divided by the police into slow-moving and rapid-moving vehicles. Much to the disgust and irritation of those moving in vehicles which really do travel at a decently fast pace, any vehicle in London moving faster than a walk claims the right to the centre of the street, and, due to the narrowness of the streets, holds back all vehicles behind it. This difficulty can only be removed by the opening of wider streets, which, even if they do not permit of three lines of traffic in each direction, will at least allow a fast-moving vehicle to move around one going at a slower pace. As a temporary expedient, it is suggested that all vehicles be required to keep to the curb until they overtake another.

London is much behind the other large cities of the world in its traffic facilities. This is indicated by the figures representing the average rides per inhabitant on the street railways and omnibus lines. This city has a population of about 6,850,000, and the average number of rides per year per head is 170. In Paris the figure is 200; in Berlin, 270, and in New York, 300. These figures do not include travel on the railroads running out of the city. Although London is some seventy-five per cent larger than Greater New York, and therefore should show a greater number of rides per capita, the actual number is less than sixty per cent of that of the smaller city. It should be mentioned that the cab travel of London is not included in the above figure.

The plans proposed by the traffic commission for changing this condition will involve the expenditure of between $150,000,000 and $200,000,000—a very large sum indeed; but it would seem none too large to meet the serious situation now existing. We in this country should watch the progress of affairs over there in order that we may profit as opportunity offers.

TOWING BY MEANS OF ELECTRIC LAUNCHES.

In a recent issue of our esteemed contemporary, the *American Shipbuilder,* an interesting suggestion is made. It is said that since many of our large coasting schooners are fitted with power apparatus for hoisting cargo, sails and for pumping, and frequently are supplied with dynamos for lighting the vessel, that this power might be still further utilized by applying it to one or two suitable launches, which could be used for towing the vessel in calm weather and for shifting her berth in small harbors. Having plenty of power at hand, the launch could easily be hoisted out, the motor connected to the dynamo by means of an insulated cable, and the vessel towed at three or four knots. At four knots an hour in a dead calm a vessel would make ninety-six miles per day, and in this way the cost of the equipment would soon be made up in towage fees and in the saving of time.

This is a very interesting suggestion. Although we are not familiar with the amount of power required for this work, it sounds reasonable. If the launch were equipped with batteries it would be of considerable service to the vessel when she lay in a harbor. For this purpose the battery equipment need not be large. It would probably be well to have the motor as large as the electrical equipment of the vessel would stand, for since, when towing, it would draw its power directly from the dynamo, the small battery equipment would not limit its output. The outlay required for this launch should not be large, and it would be quickly repaid. Even if the vessel were able to make only two knots, in the course of a day nearly fifty miles would be covered, and she would possibly be carried beyond the calm. The suggestion embodies another instance of the flexibility of electric transmission, and is one well worth trying.

ELECTRIC LIGHTING CHEAPER THAN GAS FOR THE HOME.

They are having an electrical exhibition in London, and in connection with this have secured prominent electrical men to make public lectures. A number of these have been of particular interest to the public, one especially so, since it touched upon the use of electric lights in the home. This lecture was delivered by Mr. James Swinburne, past-president of the Institution of Electrical Engineers, of Great Britain, and a past-master of the lecturer's platform. Mr. Swinburne never has difficulty in holding the attention of his hearers. He can take what, to many, would seem to be a dull subject and turn it around so that every one listens earnestly, and yet he always has some useful message to deliver and he manages to deliver it in such a way as to impress it upon the minds of those who hear him.

In his lecture, Mr. Swinburne told his audience the interesting story of the development of the incandescent lamp. Then he got down to business and showed how much superior this lamp is to the older forms of illumination in which a flame is employed. It not only gives a better light, is safer and can be arranged so as to give a better illumination, but, everything considered, is cheaper. Perhaps this would not appear true if one compared merely the cost of gas with the cost of electrical energy; and perhaps the comparison might seem still less in favor of electricity, if, as is frequently done, one changes over from gas to electricity and then compares the cost of a satisfactory lighting by the latter method with the unsatisfactory lighting by gas which preceded. Under such conditions it would be an exceptional case in which the cost for the gas alone were not less than that for electricity.

But this is only one way of looking at it. In fact, to get the two systems on a fair basis, every item should be considered. The estimates should be made for an equal illumination in each case. The relative fire risks must be determined as closely as can be, and the effect on the house of the two methods must not be overlooked. As was shown by Mr. Swinburne, the gas flame assists very materially in spoiling the decorations of a house, as well as increasing the dust and dirt. It seems that it is necessary to redecorate a London house about once every four years when gas is used; but when electricity is adopted, the house need be decorated not oftener than once in five or six years; and this is an underestimate. In fact, Mr. Swinburne is convinced that, in the long run, the electric light is cheaper than gas, even if the latter be free. This was an eminently satisfactory conclusion for the lecturer. Unfortunately, it is more difficult to persuade the possible consumer of the economy of electric lights. It is easier to work it out on the blackboard than it is to drive it through the consumer's pate—a work, by the way, to which the electric-lighting companies are devoting not a little time and energy just now. Mr. Swinburne has, however, brought out a new and interesting phase of the lighting question, of which the companies will doubtless make good use. It is one which has received almost no attention heretofore.

ELECTRICITY ON THE FARM.

Although applications of electric lights and power to farm work are few and widely scattered, occasionally conditions which permit of one or both of these applications are readily seized. An instance of this kind was reported recently from the agricultural state of Nebraska. Three farmers, having combined and installed a small gasoline engine for pumping purposes, embraced the opportunity to make further use of this engine when it was not pumping water. They secured a small dynamo, and placed it so that it could be driven from the engine. They then installed electric lights in their houses and barns, so that now they are enjoying one of the luxuries of country life—a safe, convenient and economical light.

In spite of its backward state, the application of electric power on the farm is sure to develop rapidly before long. At the present time such uses are limited generally to the estates of so-called gentlemen farmers, who farm for pleasure rather than for profit. A drawback to the wider use of the motor is its first expense; but if farmers would form groups, as has been done in the instance mentioned above, and divide the cost of the machinery among them, this objection would no longer hold. The machinery needed for such an arrangement is not large; in fact, it need hardly be larger than that required for a single farm, because, from the intermittent character of the work on the farms, it could be easily arranged so that each member of the group would have the full use of the plant for his portion of the time.

ELECTRICAL OPPORTUNITIES IN CHINA.

The recent report of Special United States Agent Burrill, who has been investigating the commercial situation in the Far East, calls attention to the opportunities for selling electrical appliances and installing electrical systems in China. This vast country is practically untouched by the electrician, for the half dozen small lighting plants in the principal cities and the one or two little electric railways there can hardly be counted in such a vast empire. True, by far the greater part of this country is utterly unprepared for electrical methods, but Mr. Burrill says that the large cities are ready, and only need to be approached properly in order to throw open their gates. There is need for not only electric light and power plants, but for electric railways and especially for well-stocked supply houses. There is opportunity for the profitable sale of electrical material and for the contractor. Although there has been some feeling against American products and methods, it should not be difficult to overcome this if the situation be properly handled. It remains for us to see that the opportunity which China offers is properly embraced. It will not do to wait until England or Germany takes the lead. The first on the ground will probably get the best of the business; and it would be just as well to keep an eye on little Japan, for she has been doing excellent work in electrical manufacturing and construction, and there is no telling where she may next appear. Certainly, she is not going to lose any opportunity for profitable expansion of her trade in the East.

THE ELECTRICAL NATURE OF MATTER AND RADIOACTIVITY.

BY HARRY C. JONES.

CHAPTER VIII.

The Alpha Rays.

It has already been mentioned that the α rays are only slightly deviable in a magnetic field, that they have very little power to penetrate matter, and that they produce most of the ionization of the gas through which the radiations from radium pass.

The study of the deviation of the α rays in a magnetic field we owe mainly to Rutherford. That they are deviated was shown by the following simple experiment. If some radium salt is placed in the bottom of a narrow tube, which, in turn, is introduced between the poles of an electromagnet, radiations from the salt will fall upon an electroscope placed directly in front of the tube. If the current is now turned on the electromagnet, any rays that are appreciably deflected by the magnet would fall upon the side walls of the tube, and would not reach the electroscope.

Since the α rays are only slightly deviable in a magnetic field, it would be necessary to have a tube of very small bore in order to be able to cause the rays to be deviated or bent enough to strike the walls. Such a narrow tube or slit between two plates would have the disadvantage that only a slight amount of radiation would escape from it. Rutherford overcame this difficulty by using a number of such slits. The radium was placed in the bottom of a box into which were introduced close together twenty or more parallel plates. The distance between the plates varied from about 0.05 to 0.1 of a centimetre. The box containing the radium and the plates were placed between the poles of a powerful electromagnet, so that the lines of force were at right angles to the path of the rays.

Certain difficulties were met with before this experiment could be successfully performed. It is desirable that the slits between the plates should be of the same length, in order that the rays may be exposed to the magnetic field for some distance. If the box containing the slits is filled with air, this would absorb the α rays quite readily and practically no result could be expected.

Rutherford overcame this difficulty by using dry, electrolytic hydrogen, which has a number of advantages over the atmospheric air. In the first place, the α rays are much less absorbed by hydrogen than by air. In this experiment it will be recognized that the α, β, and γ rays all fall upon the electroscope before the magnetic field is made, and then the β rays are deviated, but the γ rays continue to fall on the electroscope. While it is true that most of the power to ionize a gas is possessed by the α rays, both the β and γ rays have some power to do so.

The β and γ rays have much less power to ionize hydrogen than air, and thus the effect due to these rays is diminished by filling the apparatus with hydrogen. Rutherford showed that when a powerful magnetic field was used, all of the α rays were deviated. This proved that the α rays are made up of charged particles. It does not, however, show whether the particles are charged positively or negatively. If the particles are charged positively the rays would be deviated in one direction, if negatively in the opposite direction. It was found that the α rays are deviated in a direction which is exactly opposite to that in which another class of rays, known to consist of negatively charged particles, is deviated. This proves that the α rays, at least from radium, are composed of positively charged particles.

It will be remembered that the α rays are given off from all radioactive substances, and, further, that only α rays are given off from polonium. A question that should be raised and answered is this, are the α rays from polonium the same in character as the α rays from other radioactive substances? This was tested by Becquerel in 1903. He showed that the α rays from polonium are deflected in the magnetic field in the same direction as the α rays from radium. The α rays from polonium, therefore, also consist of positively charged particles.

The conclusion that the α rays consist of electrically charged particles, was confirmed by Rutherford in the following manner. The rays were passed through an electric field, and were shown to be deviated by the field. This must be the case if the conclusion that the α particles are charged, is correct.

THE RATIO $\frac{e}{m}$ FOR THE α PARTICLE.

The ratio of the charge to the mass of the α particles can be ascertained by the same general method as that which was employed by J. J. Thomson for determining the same ratio for the cathode particle. This has already been discussed at some length in an earlier paper. By studying the deviation of the rays in both a magnetic and electrostatic field, as we have seen, it is possible to determine the velocity of the particles and the ratio $\frac{e}{m}$.

Very different results were obtained with the α particles from those reached by Thomson for the cathode particles. The velocity of the α particles is about 2.5×10^9 centimetres per second, which is about one-tenth the velocity of light. The ratio of charge to mass for the α particle is about 6×10^3. While this result must not be regarded as very accurate, on account of the difficulty in obtaining a large deviation in the electrostatic field, it is still of the right order of magnitude.

It is interesting to compare this result with that obtained for the cathode particle.

It will be remembered that the velocity of the cathode particle is about 1.6×10^{10} and the ratio $\frac{e}{m} = 10^7$.

The cathode particle, therefore, moves much faster than the α particle, and has a value of $\frac{e}{m}$ which is about one thousand times as great as that of the α particle.

THE MASS OF THE α PARTICLE.

Knowing the value of $\frac{e}{m}$, we have become familiar with a method worked out by J. J. Thomson for determining the value of e and, therefore, the value of m. While these determinations have not been carried out directly for the α particles as for the cathode particle, still some light has been thrown on the present problem. We have seen that the ratio $\frac{e}{m}$ for the α particle is about 6×10^3.

The ratio of $\frac{e}{m}$ for the hydrogen ion in the solution of acids is about 10^4.

If the charge carried by the α particle is the same as that carried by the hydrogen ion in solution, as is made highly probable by our general knowledge of these substances, then we can compare the masses of the hydrogen ion and the α particle. Since $\frac{e}{m}$ for the former is 10^4, and $\frac{e}{m}$ for the latter 6×10^3, and since e in the two cases is the same, it follows that the mass of the α particle is about *twice the mass of the hydrogen ion*. It will be recalled that the determination of $\frac{e}{m}$ for the α particle is only approximate. It is therefore possible that the mass of the α particle is even four times as great as that of the hydrogen ion, in which case it would be equal to the mass

of the helium atom. We shall see that there is some evidence in favor of the view that the α particles are helium atoms.

We have seen that the α particles are projected with enormous velocities, 1.65×10^9 centimetres per second. If they have masses even as great as the hydrogen atoms or ions, with such velocities they would have a large amount of energy. This is the probable explanation of their great power to ionize a gas through which they pass, and to produce other effects with which we shall become familiar in a later paper.

THE SPINTHARISCOPE.

One other matter must be discussed before leaving the α rays. It has already been stated that strongly radioactive substances like radium, can produce fluorescence in certain substances exposed to their radiations. Thus, screens covered with barium platinocyanide or zinc sulphide, light up with a fluorescent light when exposed to the action of radium radiations.

This power of the radiations from radium to produce fluorescence can readily be shown to be due mainly to the α rays. If the α rays are cut off by a thin screen of metal, most of the power of the radiations to produce fluorescence is lost. Both the β and γ radiations can pass through the thin metallic screen, yet they have only feeble power to awaken fluorescence in the platinocyanide or sulphide.

The power of the α particles to produce fluorescence has been utilized by Sir William Crookes in a striking manner. If a screen covered with phosphorescent zinc sulphide is exposed to the radiations from radium or polonium, at a short distance from the substance, it presents a most striking appearance. The screen does not become homogeneously fluorescent throughout, but bright scintillations appear and quickly vanish. Bright points of light make their appearance, and rapidly disappear. The best result is obtained by examining the screen through a small magnifying glass. Based upon these facts is Crookes' *spinthariscope*. At one end of a metal tube is placed a piece of metal which has been dipped in a solution of radium chloride or bromide. This is suspended at a distance of a few millimetres from a screen covered with phosphorescent zinc sulphide. The other end of the tube contains a magnifying lens. This instrument has been termed a spinthariscope, from "*spintharos*," a spark.

The appearance of the screen has been described as analogous to that of the milky way as seen with the naked eye on a dark night. Bright points of light appear and quickly disappear all over the screen. These come and go in rapid succession. The effect has also been described as analogous to the splashing of drops of rain in a pool.

The cause of this striking phenomenon is probably the impact of the α particles upon the screen covered with the substance in which fluorescence can be set up. The α particles, on account of their high velocity and appreciable mass, have, as we have seen, a considerable amount of kinetic energy. When they fall upon the screen covered with zinc sulphide, they are stopped, and their kinetic energy is given up to the screen. Zinc sulphide becomes luminous when subjected to almost any mechanical disturbance. Merely rubbing it with a hard surface will render it fluorescent. Wherever an α particle falls upon the screen, that portion of the screen becomes luminous for some distance around the point of collision, and the appearance is that of a spark of light. Every spark or centre of luminous disturbance on the screen is the result of the impact of an α particle upon the screen. We thus see, as it were, the point at which the separate α particles strike the fluorescent screen, and this is, perhaps, one of the best examples of the *action of separate atoms or molecules made perceptible to any of our senses.*

Another theory of the action of the spinthariscope has been proposed by Becquerel. He thinks the scintillation is due to a fracture of the crystal of the fluorescent zinc sulphide, by the α particles. He does not think that such a fracture could be produced by one α particle, but only when a number of such particles strike simultaneously a weak point in the crystal. That light is frequently emitted when crystals are crushed, is well known. Indeed, crystals of zinc sulphide give out light when mechanically crushed, and according to Becquerel, such light has the characteristics of that in the spinthariscope. It shows the same general kind of scintillations, and the number of scintillations is dependent somewhat upon the size of the crystals of zinc sulphide with which the screen is covered. The smaller the crystals of the sulphide the larger the number of scintillations, which accords with Becquerel's view as to the action in the spinthariscope. The smaller the crystals the more easily they would be broken, and consequently the larger the number of scintillations. It is difficult at present to decide between these two views. The theory first advanced is the simpler and more fascinating, but it may not be true. More experimental evidence must be obtained before a final decision can be reached.

Successful Starting of Gas-Engine-Driven Single-Phase Railway System.

The Westinghouse interests announce the successful starting of the Warren & Jamestown alternating-current railway system operating between Warren, Pa., and Jamestown, N. Y. The electrical equipment has had several weeks' preliminary run from a small gas-engine-driven unit temporarily installed in the power-house at Stoneham. On October 19 the large gas engines were placed in service for the first time and a permanent operating schedule was inaugurated.

Probably the most interesting feature of this railway system is the exclusive employment of horizontal double-acting gas engines of the heavy-duty type for the generation of power to operate the road. Two of these engines are now installed, the first of which is already operating. The second will be placed in service in a short time. These two engines will be called upon to operate in parallel on the electrical end.

The two units installed are each of approximately 500 brake-horse-power capacity, direct-connected to 260-kilowatt revolving-field engine-type single-phase generators. Each has two cylinders arranged in tandem fashion with a single crank. They will operate entirely upon natural gas, distributed by a local company. In this district the gas has a calorific value of 1,000 British thermal units per cubic foot. A fifty-five-horse-power vertical Westinghouse engine of the single-acting type is also in operation driving air-compressor and exciting unit for the main equipment.

Current is generated directly at a voltage suitable for transmission without the use of transformers. Transformer substations are located along the right of way, which reduce the line voltage to 3,300 volts for the trolley, at which pressure it is collected by the cars.

The Warren & Jamestown Street Railway, although recently organized upon its present basis, has been running part of its present line for eleven years. Three years ago it began experimenting with gas power with sufficient success to induce the use of gas engines for the entire power generation. The successful starting of the power system will be accepted with general gratification, and will mark an important advance in modern electric railroading.

The Banquet on the New Liner Amerika.

The new liner Amerika, launched by the Hamburg-American Line, and described in the ELECTRICAL REVIEW last week, was thoroughly inspected on the evening of Tuesday, October 24, by representatives of the press, shipping and leading commercial interests of New York city. A feature of the unusually fine dinner was a lantern procession of stewards in the uniform of sailors. There were some 400 diners.

Mr. Emil Boas, general manager of the Hamburg-American Line, presided at the dinner. In his address Mr. Boas told of the development of the line. In 1886 it had twenty-six ocean steamships and twenty-three other vessels. To-day there are 149 steamers and 182 auxiliary vessels, having a total tonnage of 764,551 tons, or more than the whole ocean tonnage of countries like Russia, Holland, Sweden or Denmark.

Mr. Frank R. Lawrence, president of the Lotos Club, made a short and happy address, and the other speakers included Frederick Perry Powers, of the Philadelphia *Record;* D. W. Cooke, assistant traffic manager of the Erie Railroad; George Van Skaal, editor of the *Staats Zeitung;* the Rev. Merle St. Croix Wright; James A. Wright, of the American Line; Deputy Surveyor Bishop; General Director Ballin, of the Hamburg-American Line; Postmaster Willcox, of New York city; Surveyor Clarkson; and Lawson Sanford, of the Cunard Line.

Mr. Frank Presbrey, upon whom devolved the management of the evening's entertainment, was felicitated upon his very skilful and successful arrangement of the occasion.

Tablet Presented to the American Institute of Electrical Engineers.

At the meeting of the American Institute of Electrical Engineers, held Friday, October 27, a beautiful tablet was exhibited which has been presented to the Institute by the Associazione Elettrotecnica Italiana as a testimonial in recognition of the courtesies extended to the members of the associazione during their visit to this country in August and September, 1904.

SILVER TABLET PRESENTED BY THE ASSOCIAZIONE ELETTROTECNICA ITALIANA TO THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

The tablet is an artistic silver casting, mounted on a handsome marble slab. The design, which was executed by the celebrated Italian sculptor L. Pagliaghi, embodies medallion portraits of Volta and Franklin, and an inscription in Latin, of which the following is a literal translation:

By this testimonial the Italian colleagues place on record, for all time, their reception in gracious and generous hospitality, by their American colleagues, during the months of August and September, in the year 1904: may it be of good augury.

Rome, the thirty-first day of the month of December, in the year 1904.

The tablet will be placed in a prominent position in the Institute headquarters in the United Engineering Building, now in process of construction.

Next Annual Reunion of the Old Time Telegraphers and Historical Association and the Society of Military Telegraphers.

Preliminary steps, in preparation for holding the next annual reunion of the Old Time Telegraphers and Historical Association and the Society of Military Telegraphers, were taken in Washington, D. C., on October 26, when President William H. Young called a meeting of the executive committee, composed of the following members appointed by him: P. V. DeGraw, assistant postmaster-general; Charles P. Adams, superintendent telegraphs Southern Railway Company; G. W. Ribble, superintendent Postal Telegraph Company; E. W. Emery, Associated Press; Geo. C. Maynard, United States National Museum; H. F. Taff, manager Western Union Telegraph Company; J. H. Robinson, chief telegraph division, weather bureau.

Mr. Young is chairman of the committee. After careful consideration it was decided to fix the date of the meeting for October 9, 1906. Following the usual custom, the business meetings of the Old Timers and of the Society of Military Telegraphers will be held on that day, and the following three or four days will be devoted to carrying out the programme of entertainments, etc., which will be arranged later. It is expected that opportunities will be given for visits to all places of interest, including the White House, Capitol, Congressional Library, Corcoran Art Gallery, Smithsonian Institution and National Museum, the great naval gun factory, Mount Vernon, Arlington and the government departments. October in Washington is usually one of the most favorable seasons, and a large attendance of telegraphers and their families from all parts of the country is anticipated.

Incandescent Lamp Patent Decision.

In the United States District Court, Newark, N. J., on October 31, Judge Cross dismissed the contempt proceedings instituted by the Edison General Electric Company against James McLaren, Jr.

In rendering the decision Judge Cross stated that the complainant corporation has failed to establish proof that the defendant is or has infringed the patents owned by the Edison General Electric Company, for exhausting air from the glass bulbs.

The Largest Hydroelectric Installation in Southern Asia—IV.

***Electricity for Industrial Purposes in India*—(*Concluded*).**

By A. C. Hobble.

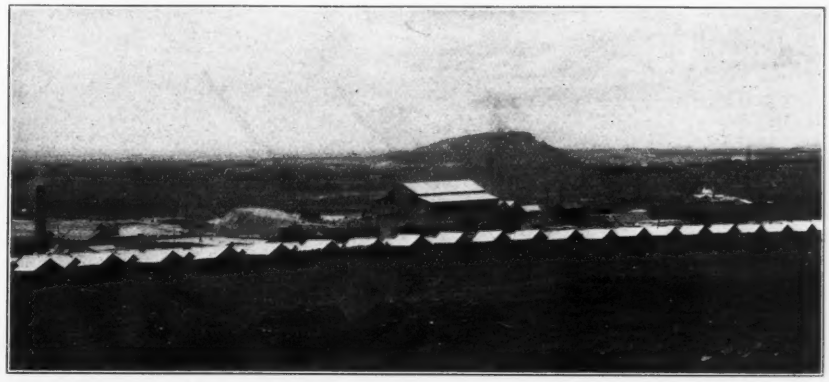
THERE are fifteen main feeder circuits tapped from the low-tension (2,300-volt) bus-bars and extending in several directions over the gold field from the low-tension distribution tower, which is located on the opposite side of the building from the transmission line entrance towers. The maximum length of distribution circuits from one end of the gold field to the other is about five miles. Altogether there are some fifteen miles of feeder circuits. Each feeder circuit is equipped with lightning arresters at the outgoing end, while at the motors both lightning arresters and fuses are provided. Each main feeder circuit is protected by an automatic relay which instantly trips the 2,300-volt oil-switch in case of very heavy overloads or short-circuits. In the new construction these relays are conveniently located on the front of the feeder panels of the main switchboard.

Some trouble has been experienced in both transformer stations with static discharges or leakage from the high-tension rubber-insulated conductors where they came into loose contact with porcelain or other insulating bushings. Rubber, even of the best quality, deteriorates more rapidly in this and in other tropical climates. Owing to the prohibitive price of pure Para or india-rubber, inferior grades are often used for the insulation of electrical conductors. Most of the inferior grades of rubber contain more or less sulphur. It is now well known that pure rubber deteriorates more rapidly through oxidation than vulcanized rubber. Owing to this fact it is of the highest importance that all rubber-insulated conductors (especially high-tension conductors) should be thoroughly tinned to prevent the oxidation of the copper from affecting the rubber insulation. It has also been found from experience that static discharges from high-tension rubber-insulated wires and cables bring about a rapid deterioration of the rubber (if the latter contain sulphur) through the formation of sulphuric acid which eats away the insulation. Owing to the static discharge it is also possible for nitric acid to be present. Hence it is very important that the prospective purchaser of rubber-insulated electrical conductors should specify the quality of the insulation and the tests which the same must withstand, not omitting that the copper conductor must be thoroughly tinned. The cheapest reliable form of rubber-insulated wire or cable is that in which the tinned conductor is surrounded by a pure rubber layer outside of which is the vulcanized rubber. The pure rubber layer prevents the sulphur from attacking the conductor.

High-tension wires and cables insulated with many layers of good quality varnished cambric have given excellent satisfaction and are much preferred to rubber insulation for high-tension work, especially in the tropics.

It has been observed that in those cases in which the rubber-insulated cable passes through porcelain bushings, the static discharge is accentuated and the rubber deteriorates rapidly. This trouble has been successfully overcome where the cable passes through vertical bushings by filling the latter with good quality insulating compound. This is not easily done where the cables pass through horizontal bushings. The remedy in this case is not to use any bushing whatever, but to have plenty of air insulation with rigid insulating supports. In case porcelain or other bushings are used, they should be of sufficient inside diameter to allow of ample clearance for the insulated conductor. This may be effected by using rigid insulating supports for the cable on either side of the insulating bushing.

Judging from experience it is not advisable to use glass insulators for high-tension currents above 20,000 volts, when such insulators are exposed to slight jars or shocks, such as are liable to occur when they are used as supports for disconnecting switches. Glass insulators used for this purpose are very apt to develop cracks



MYSORE GOLD MINING COMPANY'S DISTRICT, SHOWING STAMP MILLS AND LINE OF COOLIE HUTS.

HISTORIC BRIDGE ACROSS THE CAUVERY RIVER, NEAR SIVASAMUDRAM. NATIVE STREET IN BANGALORE TO BE SUPPLIED WITH ELECTRIC LIGHTS.

or flaws. Such defects provide a high-resistance path to ground and it is only a question of time when the insulation gives away entirely. Glass for high-tension work must be perfectly sound and of good quality. Porcelain has been found much superior as regards mechanical strength, and if of good quality is a highly satisfactory insulating material.

The iron casing of high-tension transformers, when such are located in isolated places, should not be grounded. Such grounds only increase the liability of a breakdown when abnormal pressures occur, as occasionally happens.

Champion Reef and Mysore mines, which together consume over 3,500 horse-power from the Cauvery plant, have their own substation or centre of distribution. In this way they have control of their own individual feeders. In this substation is located the necessary switchboard and switching apparatus for the control of twelve feeder circuits.

Besides the General Electric Company's motors there are to be found several Westinghouse, Sandycroft, Peebles and British Thomson-Houston companies' motors.

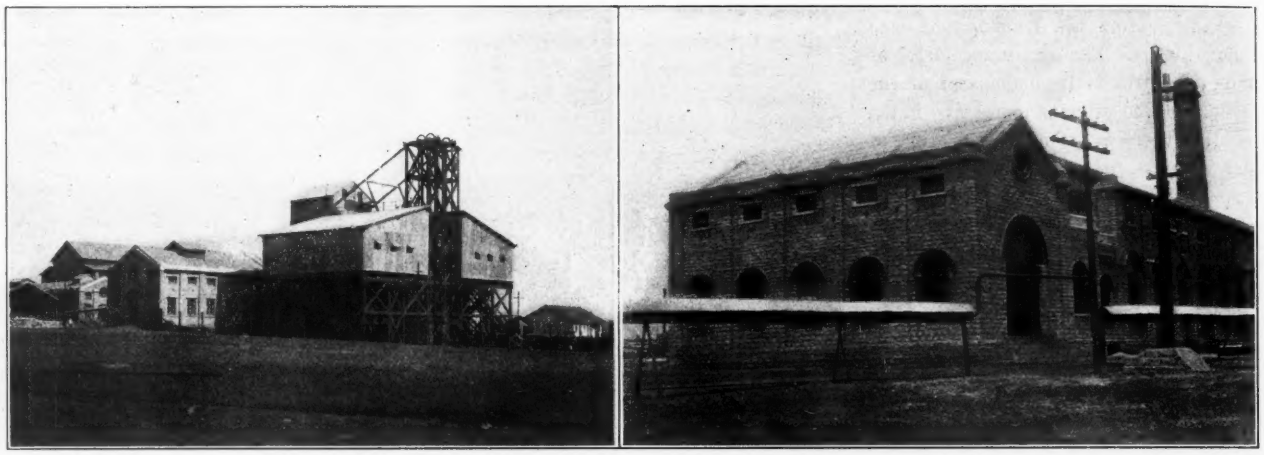
That the value of electricity in mines is realized and appreciated by the Kolar gold field mining companies is apparent by the ever-increasing demand for electric power. Motors have been installed for driving air-compressors, pumps and stamp mills, and it is to be hoped that the near future will see them installed in larger units for hoisting purposes. The electric hoist has reached a stage in which it compares most favorably with other systems and in most cases is much to be preferred.

The advent of the Cauvery power installation has been the means of supplying much cheaper power, a more constant service, and a decided saving in many other respects to the mines. The grades of coal mined in India are of low calorific value, not averaging more than sixty-five or seventy per cent. Thus with the price of coal at six dollars per ton, steam is an expensive article for motive power. The present cost of electric power delivered to the gold mines by the Cauvery power scheme is £18 (less than $90) per horse-power-year. In three years this rating will be reduced to £10 (less than $50) per horse-power-year. This will mean an enormous saving to the mines in cost of power, since great economy is effected at £18 per horse-power-year.

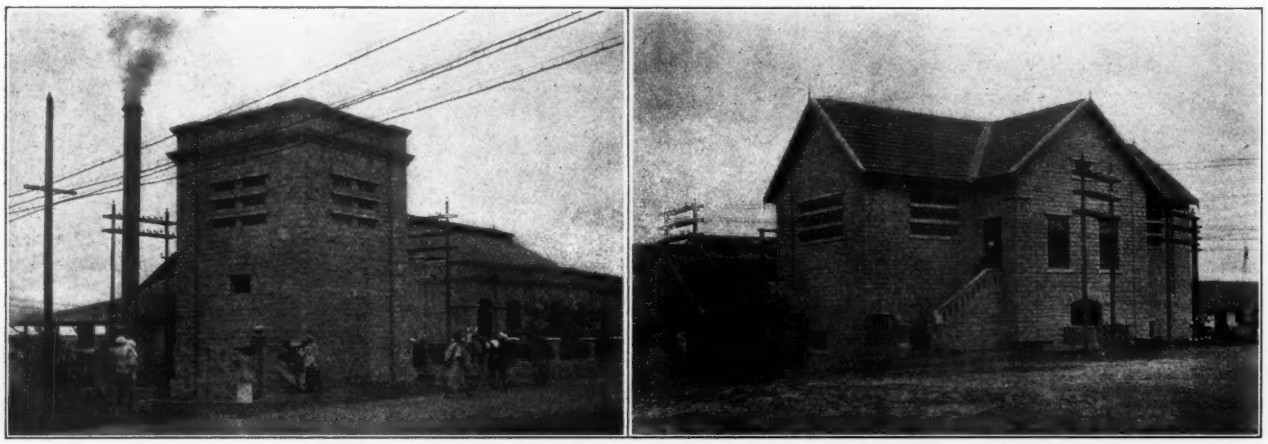
Owing to the increased demand for electric power at the mines, a third transmission line may ultimately be constructed from Sivasamudram to Kolar to supply at least an additional 2,000 horse-power. For this purpose an extra 2,000-kilowatt unit would be installed in the present generating station at Sivasamudram.

It is probable that a six-mile line will be constructed from the Kolar transformer station to Betmangala, where is located a 450-horse-power pumping station which is the main source of water supply for the Kolar gold field. The three 150-horse-power Worthington pumps are at present steam driven.

A 1,000-horse-power steam plant has



MOTOR-OPERATED ROCK-CRUSHER AND COMPRESSOR-HOUSE CONTAINING 900-HORSE-POWER MOTOR-DRIVEN WALKER AIR COMPRESSORS, CHAMPION REEF GOLD MINE—KOLAR GOLD FIELD.



STEAM-POWER STATION, SHOWING ALSO THE DISTRIBUTION TOWER, AND THE CHAMPION REEF AND MYSORE SUBSTATION—KOLAR GOLD FIELD.

recently been built and put into operation for the supply of light and a small amount of power to the gold mines. The equipment consists of four 250-horse-power

The steam plant is quite up to date, embodying two batteries each of two Babcock & Wilcox 300-horse-power water-tube boilers equipped with feed-water heaters,

PAY-DAY AT ONE OF THE MANY GOLD MINES—KOLAR GOLD FIELD.

Allen condensing engines direct-connected each to a 175-kilowatt British Westinghouse generator. Two of the steam-driven

a Green economizer, chemical softener and superheaters. Forced chimney draft is used to secure complete combustion.

OOREGAUM OLD STAMP MILL. THESE HAVE BEEN REPLACED BY A MODERN STAMP MILL.

sets consist of two generators, one of fifty cycles for lights and one of twenty-five cycles for power, mounted on the same shaft with a 250-horse-power Allen engine.

A cooling tower equipped with motor-driven cooling fans is located near the station.

All outgoing feeders are led underground from the switchboard about 100 feet distant where is located a distribution tower (see photograph) from which they are carried in four directions over the gold field.

BANGALORE LIGHT AND POWER DISTRIBUTION.

Distribution of light and power for the city of Bangalore is to be effected from one main transformer station and two smaller substations located near their respective centres of distribution. The two additional substations are necessary owing to the extent of territory to be lighted.

The transmission line voltage is stepped down from approximately 31,500 volts, as received after ten per cent loss in transmission, to 2,300 volts by means of six 150-kilowatt, twenty-five-cycle General Electric oil-cooled transformers; 2,300-volt feeder mains are run from the main transformer station to the other two substations.

In each of the substations there will be installed constant-current transformers with a primary voltage of 2,200 and a secondary voltage at full load of 3,000. Each transformer has a capacity of 17.5 kilowatts, or approximately 104 forty-candle-power series incandescent street lamps. The latter are placed on iron poles with goose-neck fixtures. The spacing is 300 feet between lamps in all of the principal streets with a gradually increased spacing toward the outskirts of the city. Also in each substation there will be installed a 110-horse-power, seventy-five-kilowatt, 720-revolutions-per-minute motor-generator set, or frequency changer, in addition to necessary feeder regulators, panels, switches, meters and fuses for general interior lighting and power distribution. A frequency of twenty-five cycles is used for the street lighting and power circuits, while sixty cycles is obtained by the frequency changers for interior lighting. The distribution for interior lighting is effected by 2,200-volt feeders radiating to local centres where are installed lighting transformers for a three-wire distribution at 440/220 volts. A 2,200-volt feeder leads to the centre of power distribution where the voltage is lowered by transformers to 230 volts for the operation of three-phase induction motors.

About 500 horse-power will be consumed by the Bangalore cotton and woolen mills and it is expected that at the least 500 horse-power will be consumed for lighting at the start. The lighting load is expected to increase to a great extent. With the day load of motors and

the night lighting load somewhat equally divided, a high load-factor should result.

Many difficulties are encountered in installing a lighting system in a city like Bangalore, where the local centres of distribution are so far apart. The carrying out of the plans for the street lighting circuits have been very difficult, especially in the native quarters and bazaars, where the streets are narrow and crooked and the houses are staggered in such a manner as to make the construction of pole lines very difficult.

The low rates charged for lighting afford Bangalore cheaper electric illumination than will be found in the majority of English, Continental and American cities, and it is evident that the residents intend to take advantage of this opportunity. Owing to the grade of material installed and attendant inspection by competent and experienced electricians the fire risk is practically nil as compared with oil lamps, and fire insurance rates should be lessened. The entire cost of installation for light and power in the city is estimated at six lakhs (£40,000 sterling or $200,000) of rupees.

Owing to the fact that it has been found necessary to obtain special sanction, under the Indian electricity act, from the government of India for the supply of light and power to that section of the Bangalore municipality known as the cantonment, the plans as briefly outlined above have had to undergo many changes. This has necessitated much delay and additional first cost to the Mysore government of the installation as a whole.

As the two smaller substations, for supplying light and power, are located within the precincts of the military station, or cantonment, it has been necessary to make arrangements for the time being to supply the city proper from the main step-down transformer station, thus overcrowding it to a considerable extent.

It seems obvious that some provision might have been made by those in authority, whereby such unnecessary delay and increased outlay might have been avoided, and the cost of illumination maintained at the original unusual low rate.

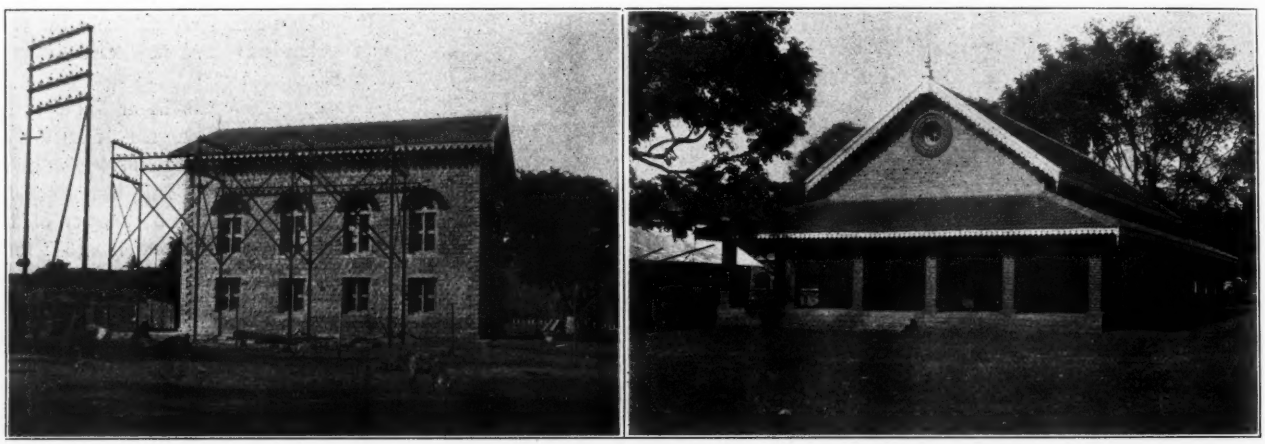
It is highly probable that the city of Mysore, the seat of government of Mysore state, will be supplied with light and power over a separate forty-mile transmission line from Sivasamudram during the ensuing year.

Owing to the rapid development and expansion of electrical projects in the state of Mysore it has been necessary to establish an electrical branch of the public works department, with the head office of the same in Bangalore. Mr. H. P. Gibbs has held for the past two and one-half years the office of chief electrical engineer to the government of Mysore. To Mr. Gibbs and other engineers on the staff of the Cauvery power scheme, the writer is indebted for many valuable suggestions and assistance pertaining to data and drawings herein given.

The state of Mysore has the proud distinction of having, in the development of the Cauvery falls power scheme, paved the way for future progress of like projects in other provinces of India. Chief among those whose efforts made possible the ultimate success of the Cauvery project were Major A. J. de Lotbiniere, R. E., deputy chief engineer to the government of Mysore, and Sir K. Sheshadri Iyer, the late dewan of Mysore, whose death before the completion of the work is to be deeply regretted.

Since the completion of the Cauvery power scheme, electrical development in many respects has shown marked progress all over India. Several hydroelectric projects are in a fair way to be realized in the near future. The writer has, from time to time, reported these in the pages of the ELECTRICAL REVIEW. At present the most important piece of electrical engineering work for which plans are being prepared is the Kashmir or Jhelum river power scheme, in northern India. This will, in all probability, include a 15,000-horse-power installation for light and power, including a large electric dredging system and a 200-mile, single-phase electric railway. Several large cities are already installing or preparing to install municipal lighting plants.

Several parts of India are rich in iron, aluminum and other mineral deposits, but owing to the high price of fuel and transportation difficulties these deposits remain undeveloped. The location of a water power within economical transmission distance affords the only available means of making these deposits a paying mining investment. Thus it is highly probable that the electric furnace may play an important part in the development of the steel and aluminum industries in India.



DISTRIBUTION SIDE OF MAIN TRANSFORMER STATION, AND OFFICE OF THE CHIEF ELECTRICAL ENGINEER TO THE MYSORE GOVERNMENT, AT BANGALORE.

Conference on Smoke Abatement.

The Royal Sanitary Institute and the Coal Smoke Abatement Society will hold a conference on smoke abatement in London, England, December 12 to December 15. The following provisional programme has been arranged:

Tuesday, December 12, 9 A. M., opening meeting of the conference and inaugural address.

Wednesday, December 13, papers and discussion on domestic smoke abatement; chairman, Sir George Livesey.

Thursday, December 14, papers and discussion on factory and trade smoke abatement; chairman, Sir William Preece.

Friday, December 15, papers and discussion on administration, legislation and necessary reforms; chairman, Sir William Richmond.

THE DIFFUSING REFLECTOR.

BY E. L. ZALINSKI.

In an article on the lighting of the New York subway, contributed to the issue of the ELECTRICAL REVIEW for August 26, Mr. E. Leavenworth Elliott criticises the use of a diffusing coating in connection with a prismed reflector, stating that the theory of the device is incorrect, and giving measurements, etc., to substantiate his point. This reflector was described in an article contributed to the *Electrical Age* of May 25, and the data given there for the gain secured by adding a diffusing coating to a prismed-glass reflector are vouched for by the report of measurements made by the Electrical Testing Laboratories, of New York city. Since, however, this device has been brought into question, it seems desirable that further data concerning its performance should be made public. The information given below is based on measurements made chiefly at the Electrical Testing Laboratories.

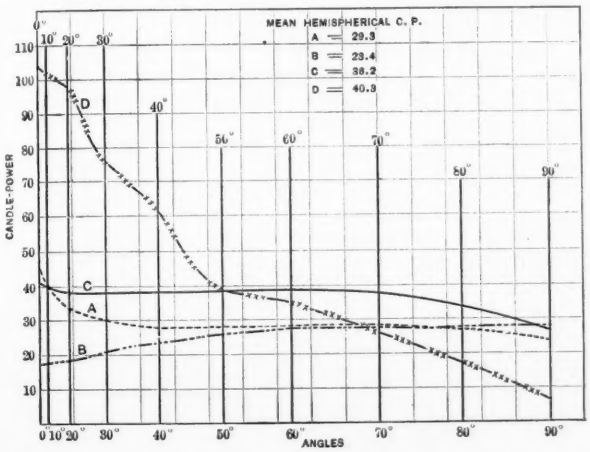


FIG. 1.—ROUSSEAU DIAGRAM.

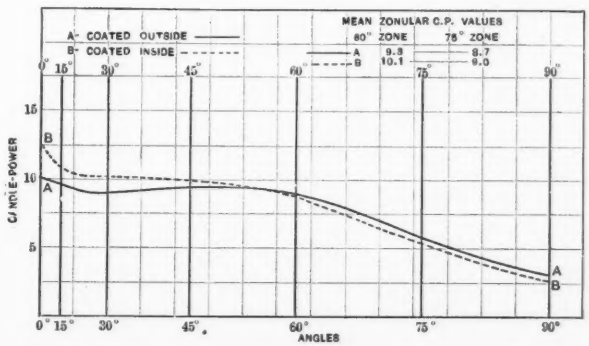


FIG. 2.—DISTRIBUTION OF LIGHT WITH A REFLECTOR COATED ON THE INSIDE AND ON THE OUTSIDE WITH ENAMEL.

In Mr. Elliott's article, surprise is expressed that such a "bull" should be made as to attempt to increase the efficiency of a prismed-glass reflector by painting it or enameling it white on the prismed side. This is quasi-acknowledgment that the results sought for might be accomplished by having the coating on the inside of the reflector; but I shall first endeavor to prove that good results are obtainable by placing the coating on the prismed side, and will then show that they may also be obtained by coatings on the inside, but without any great advantage.

In order to prove that an increase in the efficiency of twenty per cent—which is characterized as a "blunder"—is obtainable, I shall cite a series of measurements where the gains are as high as twenty-seven per cent, and where a paint coating gives a gain of 20.4 per cent. In the case of the subway lighting, which was under consideration, the claim is made for a zone of seventy-five degrees, and this should be as allowable as the claims made covering only a sixty-degree zone for the Pagoda reflectors. In one series of measurements which follows, the dimensions and shapes of the reflectors used are the same. The results show that the claims are based on exact measurements, and not on "half truths" or guesses.

Mr. Elliott discusses in his article the well-known principles governing prismatic reflectors, but these principles hold only in the single case where the source of light is a point, which is not the case when the source is an incandescent lamp. Moreover, various points militating against the securing of an ideal efficiency are ignored. Among these are the fact that the reflected ray can not equal the incident ray in any case, since each reflection must cause some loss of light. Further, the reflecting surfaces of the prism are not perfect, and the light passes through the glass twice, and must lose by absorption. For these reasons the result is less than 100 per cent effective total reflection. Considerable light which is not lost by absorption passes through the prisms unreflected. It is this portion of the light which the diffusing reflector utilizes, to a large extent, and that, too, in a manner to secure better distribution. If the optical law stated by Mr. Elliott were entirely applicable to this reflector, the actual results obtained would have been very different.

Ordinary curves of distribution of light may be entirely correct, but they are apt to be misleading when it is desired to present the real efficiency of reflectors, since the radial distances deal only with the intensities of light. The Rousseau diagrams consider, in addition to intensities, the area of the surface illuminated. Thus, the illuminating power of a source of light is proportional to the area enclosed by the Rousseau curve.

Fig. 1 represents the Rousseau curves shown in Mr. Elliott's Fig. 4, omitting curve E, which is of a fifty-candle-power lamp, and, therefore, is not properly comparable with the others, which are for thirty-two-candle-power lamps. This curve brings out the advantages of the enameled reflector used in the subway for securing a remarkably uniform distribution. The same characteristic of relative uniformity of distribution applies to other types used in the subway, thus securing a more equable and inter-helpful light.

In Mr. Elliott's Fig. 3 are given two curves of a reflector enameled on the outside, and a similar one painted on the inside; but he does not give the same prismed-glass reflector uncoated. This is unfortunate, since it would have given us an opportunity to make a direct comparison, and enabled us to show the marked gains secured by prismed-glass reflectors with the enamel or the paint backing, applied either inside or outside. The Rousseau curves of these reflectors show a character of distribution superior to anything obtainable by a clear glass-prismed reflector.

In my early experiments I obtained analogous results when the paint on the inside was fresh and glossy, and the results were lower in efficiency when the paint was dried. I found paint inferior to enamel, both for durability and appearance; but when suitable enamel was used, either inside or outside, on absolutely similar reflectors, the results were practically identical. Each had a slight

advantage at one end of the curve, but compensated for this at the other. This effect is shown, in a measure, in Fig. 2, but is also in evidence in numerous other measurements.

Many measurements have been made,

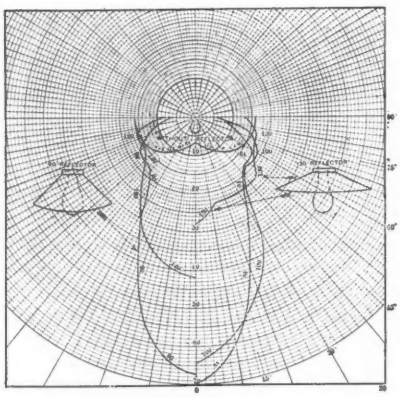


FIG. 3.—DISTRIBUTION WITH PRISM-GLASS REFLECTOR WITH DIFFERENT ANGLES OF OPENING.

with various classes of reflectors, in endeavoring to learn how these might be improved. It was evident that the goal to be attained was to broaden the distribution. It is not difficult to secure *depth* of curve—that is, intensity of illumination—by modifications of shapes of the reflectors, but it is not as easy as Mr. Elliott claims, to secure broadened distribution by so doing. For these tests, prismed-glass reflectors were made from the same mould, but given different angles of aperture while in the plastic state.

Fig. 3 represents curves of distribution of light about prismatic-glass reflectors having angles of aperture approximately eighty-four degrees, ninety degrees, 100 degrees, 120 degrees and 130 degrees, respectively. These curves show that the increased angle of aperture results in decreasing the downward distribution, with no appreciable increase in intensity in their higher angles. Investigations made to determine how the opening of the reflectors affects the reflecting capabilities of the prisms, demonstrated that there is no appreciable loss due to this; and, in fact, in some cases, a slight gain was found.

A study was made of reflectors of various shapes and material. The curves from these reflectors showed that the porcelain reflectors secured an advantageous distribution, but were lacking in intensity. The prismed-glass reflectors gave great intensity, but were lacking in breadth of distribution. The latter also were objectionable on account of their injurious and disagreeable glare when viewed at certain angles. The relative efficiencies and the character of the distribution of these types of reflectors are shown in Fig. 4. Curve "A" shows the distribution of an eight-inch porcelain reflector, and curve "B" that of an eight-inch clear-glass prismatic reflector. The character of the curve of the white porcelain reflector is evidently chiefly due to diffusive action, while that of the clear-glass prismatic reflector may be characterized as reflection.

In order to make clearer the distinction between diffusion and reflection of light, I quote the distinction given by Professor William Hallock, of the department of physics, Columbia University.

"I do not see how any one can contend that diffusion and regular reflection are the same phenomenon. Of course, one may say that they are both due to difference in the optical properties of two media. Nevertheless, it is generally un-

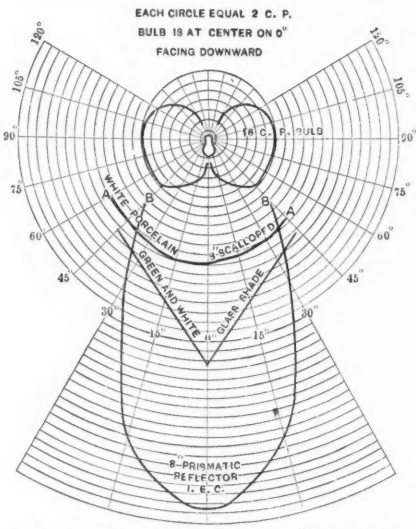


FIG. 4.—ILLUMINATION WITH EIGHT-INCH PRISMATIC REFLECTOR; TEN-INCH GREEN AND WHITE SHADE; EIGHT-INCH WHITE PORCELAIN, SCALLOPED.

derstood that by reflection we mean the case where the majority of the light is sent off at an angle equal to that of the incident light, and all in one direction. Scientifically stated, it is the case where the light, on leaving the surface, has a simple, well-defined wave front. In diffusion, the light, leaving the surface, goes off in directions bearing no relation to the direction of the incident light; in fact, in all directions in a general plane of incidence. In this case the light has no simple, well-defined wave front, but a complex multitude of little waves traveling in all directions and not uniting in one general wave."

From the preceding investigations the conclusion was arrived at that the distribution might be made better by coating the prismed-glass reflector with white porcelain, enamel, or other light-diffusing material, retaining at the same time a considerable portion of the directly downward intensity of light. Such coating also tends to reduce the injurious and disagreeable glare of the clear-glass reflectors, and better satisfies æsthetic and artistic requirements. The enamel used finally is sufficiently translucent to prevent dark spots above the reflectors.

In Fig. 5 are shown the results of the experiments. This gives the curves due to various similar thirteen and one-half-inch reflectors with three oval-filament lamps, in a Benjamin cluster. The curves relate to the following reflectors: "A" is the distribution of light given by a clear-glass prismed reflector; "B" shows the result with an opal reflector alone; "C" shows the combination of an open reflector, superimposed on the clear-glass prismed reflector; "D" shows the distribution produced by the clear-glass prismed reflector with a backing of special white paint No. 1; "E" is the curve for the same reflector with an enamel coating. In all cases, care was taken to have the planes of the oval filaments of the lamps parallel to the surface of the reflector.

The plain prismatic glass gives 52.9 candle-power as an average throughout the lower seventy-five-degree zone. The opal reflector gives 54.3 candle-power, and the combination of the two gives 63.2 candle-power, a greater value than either alone. The reflector coated with white paint No. 1 gives 63.7 candle-power, greater than the combination of plain

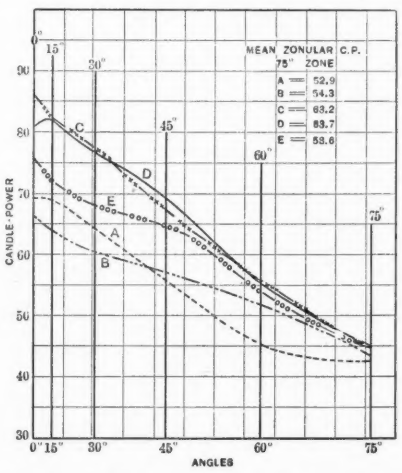


FIG. 5.—ROUSSEAU DIAGRAM, ILLUMINATION WITH VARIOUS THIRTEEN AND ONE-HALF-INCH REFLECTORS.

prismed glass and opal reflector. The reflector coated with enamel gives 58.0 candle-power. In the cases of the painted and enamel-coated reflectors, most of the values given by the plain prismatic-glass reflector, due to its action in reflecting

the light, are retained, plus an addition due to the diffusive action of the coating of paint or enamel; and it is to be noted that the gain in efficiency due to the superimposed coating more than counterbalances any loss due to prismatic reflective

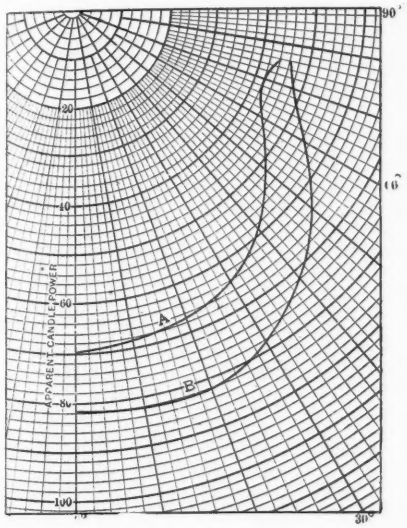


FIG. 6. — DISTRIBUTOR ABOUT THREE-LAMP CLUSTERS WITH CLEAR-GLASS AND COATED-GLASS REFLECTOR.

action, being assumed to be reduced as a result from the application of the coating on the glass prism. The reflectors used in these cases had about 140 degrees aperture. The clear-glass prismed reflector gives results inferior even to those obtained with the opal reflector.

The relative values of the clear-glass prismatic reflector and the same backed with white paint No. 1 are shown in distribution curve Fig. 6. The enamel prismatic glass does not give quite as favorable results as does the painted one, but gives better results than either prismatic glass or opal alone. This tends to prove the contentions, that the prismatic-glass reflector receives reenforcement by the light-diffusing action of the white enamel, as it clearly does when backed by the proper coatings of white paint. It also gives a marked improvement in the changed and bettered distribution, and the avoidance of glare below, dark spots above, and generally improved appearance. The advantages gained by the use of a diffusing coating is shown in curve "B," curve "A" being that of a similar clear-glass reflector (see Fig. 7).

The gain due to the action of the diffusing coating is not shown entirely by the added values in candle-power. The average values may even be identical, but in the one case we may have high values—too high for comfort—over one part of the field, and values too low over the other parts. The gain is very largely in the better general distribution obtained, which can not be well expressed numerically. An inspection of the curves presented will convey this better than can the average values expressed in figures. To put these values in a manner which will convey a just conception, it is suggested that the mean values be stated as at present, with the maximum and minimum values given in the zones from zero to ninety degrees, placed one over the other. For example, the value of curve "D" (Fig. 6 of Mr. Elliott's article) would, according to this classification, be 40 104/6 candle-power; and curve "C," similarly, would be 32.2 40/26 candle-power. The former implies a value of sixty-four candle-power above, and thirty-six candle-power below, the mean value. The last would mean 4.8 candle-power above, and 10.2 below, the mean value.

Further experiments were made, showing clear prismatic-glass reflectors with coatings of white blotting-paper, blotting-paper pulp, asbestos, mineral wool, spun glass, and superimposed white opal reflectors, together with various kinds of enamel and paint. The results are shown in the Rousseau curves reproduced in Fig. 7. All of these tests were made with a thirteen and one-half-inch prismed-glass reflector with about 140 degrees opening, having a Benjamin cluster with three oval-filament, sixteen-candle-power lamps. The lamps were adjusted so that the planes of the filaments were, as nearly as possible, parallel to the inner surface of the reflector.

The results are given in the following table. It should be noted that for curve "I," a fourteen-inch opal reflector was used, the outer edge of which was covered with black tape to reduce the reflecting surface to thirteen and one-half inches in diameter.

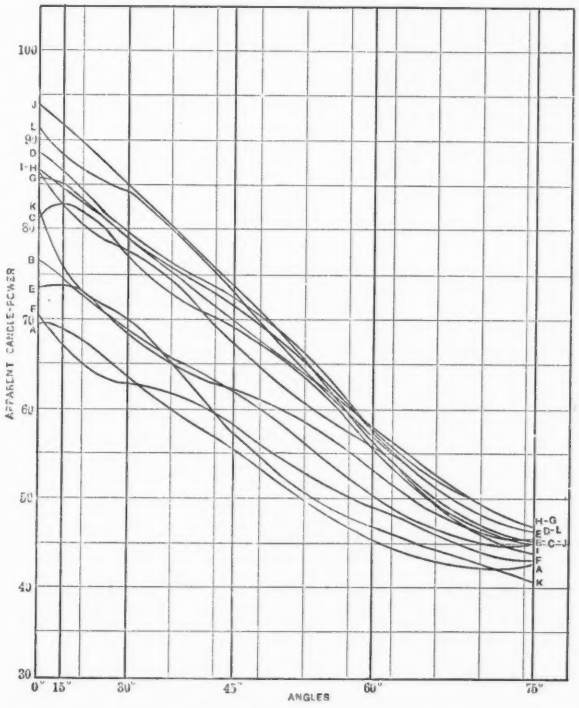


FIG. 7.—DISTRIBUTION OF LIGHT, WITH DIFFUSING AND VARIOUS OTHER REFLECTORS.

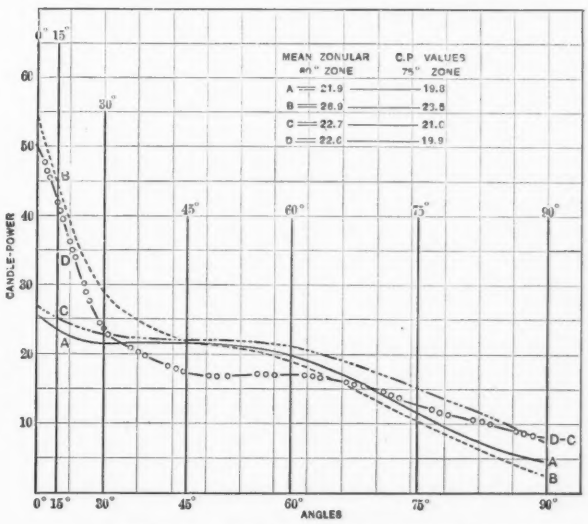


FIG. 8.—DISTRIBUTION OF LIGHT WITH VARIOUS REFLECTORS.

The question arose, whether the improved results shown by the coated reflectors were due to increased reflection or to diffusion. To test this, a second clear-prismed glass reflector was closely super-

imposed upon the first. The results are shown in curve "K." At zero degrees the curve is somewhat high, but it rapidly falls to a minimum. This appears to show that the improved results were due to diffusive action of the superimposed reflectors or the white or whitish coatings. As is seen, such coatings tend to maintain the curve relatively high until the ninety degrees is attained, meaning that the light is distributed over a broader field than when the curve at zero degrees and adjacent angles shows a higher candle-power, after which it falls off rapidly.

Further investigation showed that the direct gain in candle-power in the lower hemisphere, probably due to the added diffusive action, was varied somewhat according to the shape or angles of the opening of the reflector. The wider openings gave better aggregate relative results with the diffusive coatings than did reflectors of smaller openings. The former are particularly advantageous in cluster lighting, where the lamps are placed radially, close to the surface of the reflector. But in all cases there was a decided improvement in distribution of the light, while the total available candle-power was about the same, or a little greater, even with the smaller-angled reflectors. Fig. 8 shows this effect. The curves here represented are for smaller reflectors. This figure is also of interest in showing again that the prismatic white-coated reflector gives better results than a plain opal reflector or a plain prismatic-glass reflector of similar angle of aperture alone. In this figure, curve "A" is the distribution of an approximately right-angles opal reflector of seven and one-quarter inches diameter; curve "B" is the distribution for a similar plain prismatic-glass reflector seven inches in diameter; curve "C" is the effect of these two reflectors combined, the opal reflector being superimposed; curve "D" was obtained with a white enamel-coated prismatic-glass reflector similar to the reflector used for curve "B." The opal reflector has at least 5 per cent greater area than the plain-glass reflector.

The same comments apply to these curves as to those shown in Figs. 5 and 7.

It may be added that, acknowledging the correctness of the optical law quoted by Mr. Elliott, it is fair to assume that the enamel coating has a different index of refraction from the clear glass, and therefore the law cited does not apply. The enamel fuses at a lower temperature than the glass, and is thus applied without destroying the smooth reflecting surface of the prisms.

It is inevitably the case, when practical results do not accord with theoretical dogmas, that these last are either wrongly stated or wrongly applied. The statement made by Mr. Elliott as to crown glass and balsam is correct, as these two have the same index of refraction (1.53); but it is overlooked that the indices of various clear glasses differ, such as, for example, flint glass—1.58; thallium glass being as high as 1.75, etc. Although enamel is vitreous, it need not from this fact necessarily have the same index of refraction as the glass; indeed, it would appear at the outset that this translucent, but not transparent, material would be likely to have a different index of refraction from the clear glass used in the reflectors on which it is superimposed. And this appears to be substantiated by actual measurements—for, superimposed on the clear-glass prismatic reflector, it secures results superior to this clear-glass prismatic reflector above, or to the reflector of opal, to which latter Mr. Elliott likens it.

The results given above show clearly that there is some gain in the amount of light made available by the diffusive coating, since it acts upon light otherwise lost. But the more important gain is the better distribution obtained by the use of reflectors with a diffusive coating either inside or outside.

It must be obvious that it is better to have, at zero degrees, a moderate but sufficient degree of intensity—provided it is well maintained—than to have an intensity highest at this point, decreasing rapidly toward the upper zones. By so doing we avoid the objectionable contrasts resulting from very dark and light spaces.

It was not expected, by the use of the diffusive coating to other similar methods, to create light; but the effort was made to avoid having it all in a limited space, and to modify the distribution so as to secure the maximum benefits. In other words, it was attempted to put the light where it would do the most good, and to avoid a superabundance in one place, with the resulting, and equally harmful, contrasting insufficiency in others.

RESULTS SECURED WITH VARIOUS REFLECTING SURFACES—(SEE FIG. 7).

Character of Reflectors and Backing.	Mean Intensity for 75° Zone of Lower Hemisphere. Candle-Power.	Variation of Efficiency for This Zone. Per Cent.
Test A—Clear prismatic glass reflector only	52.9	Basic value
Test B—Clear prismatic glass reflector backed by similar white reflector	57.8	+ 9.3
Test C—Clear prismatic glass reflector with white paint on back	63.7	+20.4
Test D—Clear prismatic glass reflector with white blotting paper on back	65.8	+24.4
Test E—Clear prismatic glass reflector with white paint No. 2 on back	59.1	+11.7
Test F—Clear prismatic glass reflector with dust on back	55.7	+ 5.0
Test G—Clear prismatic glass reflector with blotting paper pulp on back	66.2	+25.0
Test H—Clear prismatic glass reflector with mineral wool on back	65.6	+24.0
Test I—Clear prismatic glass reflector with white opal superimposed	63.0	+19.0
Test J—Clear prismatic glass reflector with spun glass on back	67.4	+27.0
Test K—Clear prismatic glass reflector with another clear glass superimposed	55.7	+ 5.0
Test L—Clear prismatic glass reflector with asbestos wool on back	67.1	+27.0
Test M—Opal reflector only	54.3	+ 2.0
Test N—Clear prismatic glass coated with enamel inside, heavily	59.6	+13.7
Test O—Clear prismatic glass coated with enamel inside, lightly	56.5	+ 7.0

Lectures before the New York Electrical Society.

The New York Electrical Society has announced a very fine series of lectures to be given during the season of 1905-1906. The schedule is as follows:

"Electrical Reactions of Gases," Peter Cooper Hewitt.

"Wireless Telegraphy," William Marconi.

"Electrification of the Long Island Railroad," O. S. Lyford, Jr.

"Newspapers and the Telegraph Art," Melville E. Stone.

"The Turbine," C. G. Curtis.

"The Place of the Electric Vehicle in Automobilism," Robert McAllister Lloyd.

"Single-Phase Railway Work," Charles F. Scott.

"The Block System in the New York Subway," J. M. Waldron.

Maps of Independent Telephone Systems.

The National-Interstate Telephone Association has completed a map of Ohio, showing about seventy-five per cent of the independent toll lines in that state. Data for a large number of the lines not shown have been received since the tracing for the present map was made up. All of these lines will be included in a later edition. Maps of the systems of independent telephone companies in other states are also being prepared.

The association is revising its mailing list, and is desirous of securing a list of the officers and directors of every independent company in the United States.

During November a meeting of the executive council will be held.

The Electrification of the Long Island Railroad.

THE western division of the Long Island Railroad consists of numerous lines within the limits of the city of New York, and while the main terminus of the road is in Long Island City, opposite Thirty-fourth street in the borough of Manhattan, the road has another very important terminus at the intersection of Atlantic and Flatbush avenues, in the borough of Brooklyn. The line to the latter terminus is four-tracked from Jamaica to East New York, thence double-tracked through Atlantic avenue to Flatbush avenue. It originally traversed open farming country, but the enormous growth of the outlying districts of the borough of Brooklyn has resulted in building up almost solidly the section traversed by the railway line from Flatbush avenue out to East New York, and even beyond as far as Atkins avenue, a distance of five and one-quarter miles.

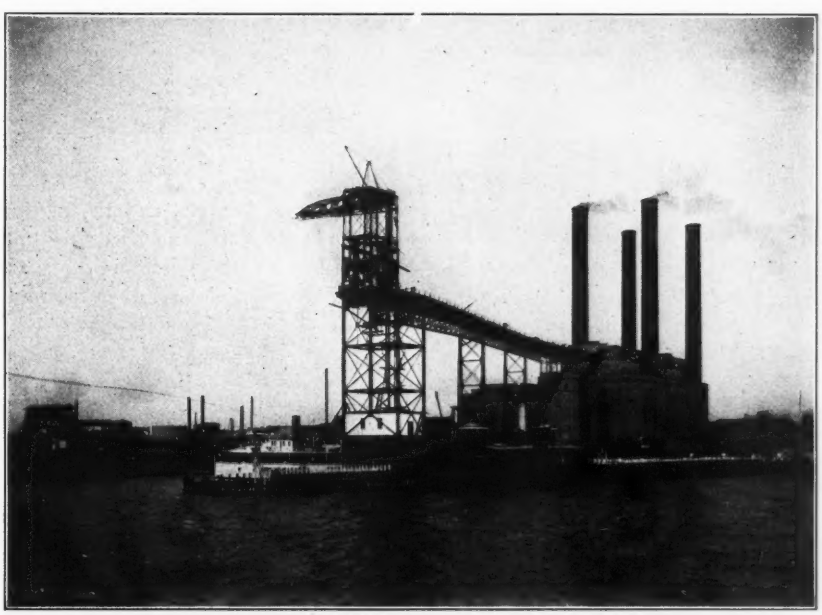
On agreement with the city, dated May 18, 1897, the railway company undertook to remove its tracks from the surface of Atlantic avenue, and to operate passenger trains on the line by a motive power not requiring combustion. This requirement obviously pointed to electric traction, and the planning of a satisfactory train service in this short section has resulted in the installation of the most extensive system of electrification yet put in operation on any steam railway in the world.

It is our purpose in the present article to describe the main features of this important and interesting installation in its general scope, leaving for future articles the description in detail of the equipment.

NATURE OF TRAFFIC.

As before stated, the Long Island Railroad at the extreme west end of the island consists of a network of lines, having two important city terminals, and conducting a heavy through as well as local service. The Flatbush terminal is in the heart of the borough of Brooklyn, and connects at that point physically with the Brooklyn Rapid Transit elevated lines leading to the Brooklyn bridge and to the Broadway ferry; it will also soon connect with the subway and tunnels being constructed by the Interborough Rapid Transit Company from the Battery in the borough of Manhattan, under the East river, and thence to Flatbush and Atlantic avenues. It will be seen that, upon completion of the subway tunnel, passengers arriving at the Flatbush avenue terminal, from points on Long Island, will have a short and direct route to the lower business section of Manhattan Island, by either the subway or by elevated lines over the Brooklyn bridge. Furthermore, direct connection will be established by the elevated lines over the new Williamsburg bridge.

The regular service on the Atlantic avenue line consists not only of suburban trains carrying passengers from towns on the south and north shores of the island, but also quite heavy local business from Flatbush avenue out to Jamaica, and very heavy excursion business to Rockaway Beach and three different race-tracks, located at Aqueduct, Metropolitan and Belmont parks respectively.



EXTERIOR VIEW OF LONG ISLAND CITY POWER-HOUSE.

EXTENT OF ELECTRIFICATION.

Considering the complicated train service above referred to, it was obviously impossible to adopt an electrification plan which contemplated electric haulage for part of the journey and steam haulage for the remainder of the journey to the principal points, beaches and race-tracks, inasmuch as transfer of passengers en route to these points would occasion endless confusion and delay. It was therefore determined, in spite of the fact that immediate return on the very heavy outlay could not be expected, to electrify all lines leading out of the Flatbush avenue terminal upon which heavy suburban or excursion business took place. This resulted in practically the electrification of the entire road south of Atlantic avenue and the main line out to Queens, and as far east on the Montauk division as Valley Stream. It was not found necessary to electrify the line north of this dividing line, as no through traffic from Flatbush avenue to the terminal in Long Island City at present exists. When the tunnel lines to the borough of Manhattan, now being constructed by the Pennsylvania Railroad Company, are completed, a new set of conditions will be introduced which will require very considerable extension of the electric service, and will, no doubt, comprehend at that time all the lines of the company for, say, twenty-five miles out of both terminals.

The diverse character of the train service and its very fluctuating loading at different seasons of the year, due to the character of excursion business, formed a condition the reverse of favorable for economical electric traction, for the reason that the load-factor on any of the fixed portions of the complete system as power-house and transmission lines, would necessarily be a very low one throughout the year. In spite of this very great handicap, which meant an enormously heavy initial expenditure, the management of the railroad determined to provide complete electric service at the outset, having faith that the improved facilities afforded would result in the growth of the territory adjacent to its line, and in the end afford it a fair

return on its investment. It must be confessed, however, that for the present, and probably for some time to come, the expensive pioneering done by the company will result chiefly in increased convenience to its patrons rather than in enlarged net revenues.

Under normal conditions the loading of the power plant and the substations will be comparatively light, but in order to take care of the heavy race-track and excursion movement a power capacity has been installed sufficient to move simultaneously the following service:

Flatbush Avenue to Belmont Park—Fifteen six-car trains per hour in each direction.

Flatbush Avenue to Rockaway Park—Three six-car trains per hour in each direction.

Valley Stream to Hammels—Two four-car trains per hour in each direction.

In addition to the above, power is supplied for the trolley-car service between Rockaway Park and Jamaica.

SYSTEM ADOPTED.

A decision upon the character of the equipment and the characteristics of the electrical apparatus involved reference to the possibilities of connecting with the lines of neighboring companies, including the Brooklyn Rapid Transit Company, the Interborough Rapid Transit Company and the Pennsylvania Railroad tunnels, as well as the physical character of the lines of the Long Island Railroad itself. In coming to a decision upon the work, therefore, operation over elevated lines, in subways, on the surface and also in the Pennsylvania Railroad terminal and tunnels had to be harmonized. It was decided, therefore, to adopt for the car equipment a type and dimension of car which would permit, if necessary, of through operation over connecting lines. It was also decided to adopt a system of electric distribution which was standard on connecting lines; namely, third-rail contact and direct current at 600 volts for the propulsion current, and alternating-current transmission at 11,000 volts for conversion at substations.

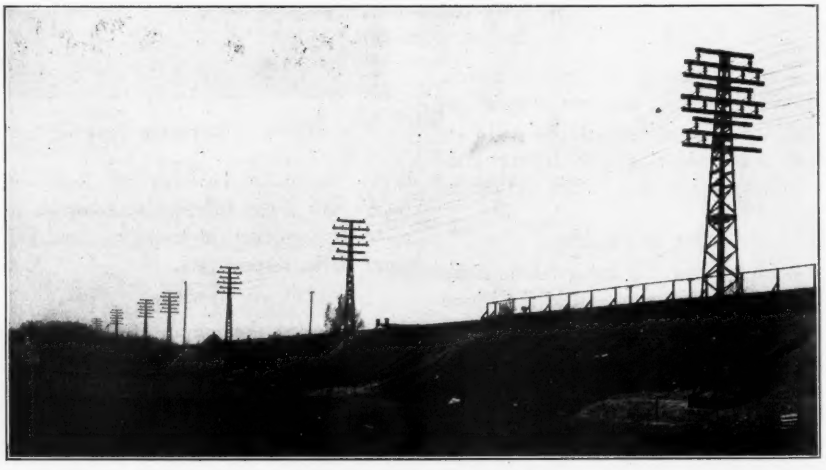
GENERAL LAYOUT.

Current for the entire system will be generated at the large power-house now nearly completed at Long Island City. This power-house will eventually be one of the largest in the world, and has the distinction of being entirely equipped with steam turbines. There are at present installed three Westinghouse-Parsons turbine units of 5,500 kilowatts capacity each, and the engine room provides facilities for three more such units. It will be noticed that this power-house does not stand in the centre of gravity of the electrified system at present, but it must be remembered that the Long Island electrification forms a part of the general scheme for the operation of the Pennsylvania Railroad terminal and the moving of trains in the North and East river tunnels. When all these improvements are in complete operation, and when the western division of the Long Island Railroad is entirely electrified, the Long Island City location will be in about the centre of distribution.

The three-phase alternating current generated at the power-house is carried in conduits through the built-up portion of Long Island City as far as the railroad yards. From here the cables are brought overhead and carried on a specially designed lattice steel pole line. The construction of this pole line is most interesting and represents an advance over anything hitherto attempted in this direction. The poles are of very strong construction and are mounted on concrete foundations. Wherever the transmission lines cross telegraph or telephone wires, the later are led underneath the high-tension wires; the very substantial character of the heavy electric cables precluding their breaking and falling across the telegraph wires. A further precaution is taken by having the poles placed closer together at such points.

TERMINAL FOR ELECTRIC TRAINS AT BELMONT PARK.

This pole line follows the railroad tracks to Winfield, from which place it is led across country on a special right-of-way to Glendale Junction, where it again follows the railroad to the substation at Woodhaven Junction. At this point the lines branch off in the direction of the different substations.



TRUNK TRANSMISSION LINE BETWEEN LONG ISLAND CITY AND WOODHAVEN JUNCTION.

In a transmission line of this kind where bare wires are used, there is always a certain amount of danger to be feared from the effects of lightning. This has been very carefully guarded against in the present installation, as lightning arresters have been placed in all substations and special arrester and cut-out houses have been erected at all places where the transmission wires are led from overhead

and carried in underground or submarine conduits and vice versa.

The substations are five in number and are located at the following places:

Substation No. 1, Grand and Atlantic avenues, Brooklyn; substation No. 2, East New York; substation No. 3, Woodhaven Junction; substation No. 4, near Rockaway Junction; substation No. 5, Hammels.

As far as possible every one of the substations has been located at junction points, such points being more practicable as they are the points at which the heavy loads occur. Such locations also make it possible and convenient for the arrangement of transfer switches for the high-tension circuit.

Taking up now the equipment of the different substations; the one at Woodhaven Junction is the largest of all, being provided with an initial equipment of three 1,500-kilowatt rotary converters and nine static transformers of 550-kilowatt capacity. Ultimately this station will be equipped with six 1,500-kilowatt rotary converters with a corresponding increase in the number of static transformers.

The Grand avenue substation is provided with an initial equipment of three 1,000-kilowatt rotary converters and nine static transformers of 375-kilowatt capacity. The ultimate capacity, however, will include four 1,500-kilowatt rotary converters with a corresponding increase in transformer capacity.

It might be said here that all these substations, which are now equipped with 1,000-kilowatt rotary converters, are provided with foundations of sufficient size to accommodate converters of 1,500-kilowatt capacity. The idea being that as soon as the present substations reach their maximum capacity with 1,000-kilowatt converters, the sections of railway, electrically equipped, will have extended far enough to warrant the building of more substations further out on Long Island. It will therefore be possible to move the 1,000-kilowatt converters from their present stations to the outlying ones and erect in their places converters of 1,500-kilowatt capacity.

The Rockaway Junction substation is provided at present with an initial equipment of two 1,000-kilowatt rotary converters and six static transformers of 375-kilowatt capacity. The ultimate equipment will include four 1,500-kilowatt rotary converters and the proper number of static transformers.

The East New York substation has an equipment of three 1,000-kilowatt rotary converters with nine 375-kilowatt transformers, while the ultimate equipment will consist of four 1,500-kilowatt rotary converters and the corresponding number of transformers.

The substation at Hammels is equipped with two 1,000-kilowatt rotary converters and six 375-kilowatt transformers. Ultimately, however, it will contain six 1,500-kilowatt rotary converters with a corresponding increase in transformer capacity. In addition to the above, this substation

VIEW IN ENGINE ROOM, SHOWING TURBO-GENERATORS.

is provided with a storage battery of 2,000 kilowatt-hours capacity, making it the largest storage battery in the world in use for electric railway work. Its installation was deemed expedient owing to the fact that the Hammels substation is the farthest from the power station and the transmission line is exposed to an unusual extent, being carried over Jamaica bay for four miles. Furthermore, the load at Hammels is very light during the winter and the very large battery capacity makes it practicable to shut down the rotary equipment for much of the time during the winter months.

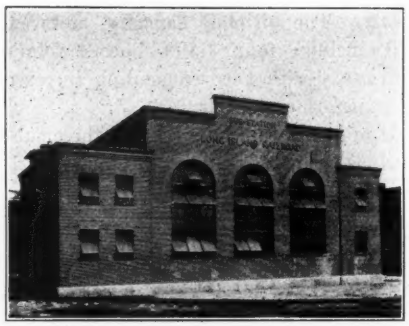
In external appearance all these substations very much resemble each other, being built of brick and steel and of fireproof construction throughout. They also conform closely in interior arrangement, the rotaries and transformers being set up on the first floor, while the main switchboard is placed in a gallery on one side of the building from which the operators have an uninterrupted view of all the machinery under their control. The high-tension cables are led to a carefully insulated board on the other side of the building facing the main switchboard.

Before leaving the subject of substations, it might be well to mention that all of them are provided, on emergency, with the means of augmenting their capacity to the extent of 1,000 kilowatts through the use of portable substations. These consist of steel cars, each carrying a 1,000-kilowatt rotary converter and three static transformers. Two such portable substations have been built. They were designed primarily not only to reenforce the permanent substations, but to maintain the potential at any points where traction might, temporarily, be very heavy. Such conditions would be met at the different race-tracks, and therefore buildings have been provided at Belmont Park race-track and at Springfield Junction, near the Metropolitan race-track, where these portable substations may be housed and connected up.

While the use of portable substations is not new, yet it is interesting to know that they are being used on a larger scale in this installation than has ever before been attempted. One reason for their extensive use is found in the fact that no feeders are used for supplying the third rail, the high conductivity of these rails permitting of the dispensing of feeders for all ordinary conditions of traffic.

THIRD RAIL.

Direct current, at a potential of 600 volts, is led directly to the third rail from the different substations and is carried in this way to considerable distances, great care being taken with this third-rail installation to guarantee the safety of pedestrians, and no expense has been spared to attain this result.

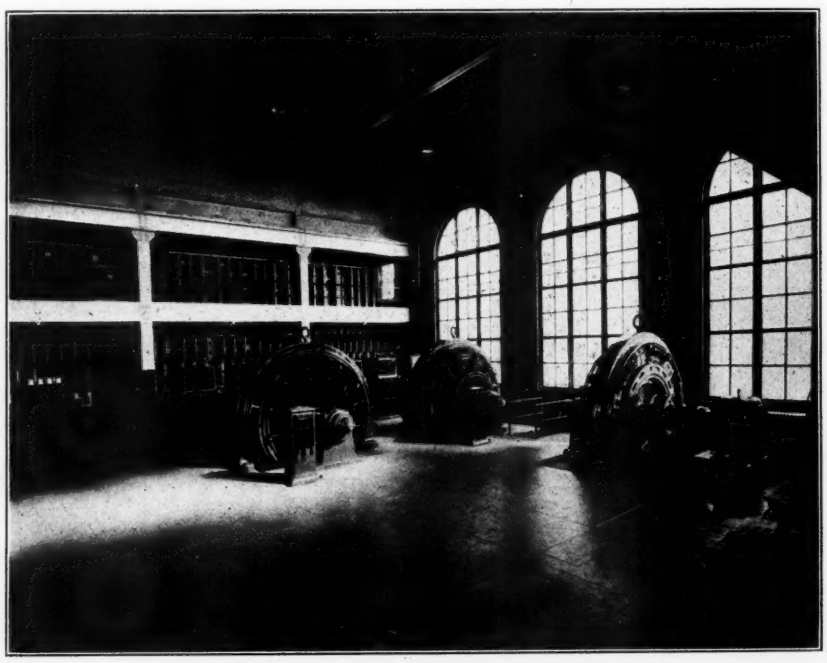


EXTERIOR VIEW OF EAST NEW YORK SUBSTATION.

The rail is laid at the standard distance from the track rail adopted by this road, the Pennsylvania Railroad and the Interborough Rapid Transit Company; namely, twenty-seven inches from the gauge line of the track to the centre line of the third rail and with top of rail three and one-half inches above the top of the track rail. Placing the third rail in this position will allow of interchange between the above-named railroads and will permit of proper clearances for steam equipment, especially the steel hopper cars now in general use.

The rail is laid on sleepers, which extend at intervals beyond the line of track, and is supported by insulators made of vitrified clay. It is covered throughout its entire length by a wooden sheathing held in place in the following manner: brackets of steel attached to the rail are firmly bolted to wooden uprights outside the rail, and to these, by separate bolts, are attached a second set of strong brackets, supporting a plank two inches thick, and at a height of about four inches above the rail. Wherever the rail is led in front of stations, a special side sheathing is attached to both sides, making it practically impossible for pedestrians to come in contact with it. Another feature in connection with the protection of passengers at stations is the fact that a running board, similar to the one covering the third rail, is led along the outside edge of the platform and effectually prevents passengers from coming in contact with the collector shoes of the motor cars.

At either side of a grade crossing the third rail terminates in a broad sloping shoe, similar to that at switches and crossings in the subway, or on the Manhattan elevated. This is considerably within the line of protecting fences which enclose the entire right of way, and a heavy insulated wire cable connects it with the third rail, similarly situated beyond the break; the cable passing underground in a concrete duct situated at a depth not likely to permit of interference by crossing repairs.



INTERIOR VIEW OF EAST NEW YORK SUBSTATION, SHOWING HIGH-TENSION GALLERIES.

The total mileage of third-rail installation reduced to single-track basis is ninety-seven and one-half. This is divided up in the following manner: miles of main

line equipped, forty-two; main line, single-track mileage equipped, ninety; sidings, seven and five-tenths; making a total of ninety-seven and one-half miles for the system.

TRAINS.

The trains at present are made up entirely of steel motor cars, of which 130 have already been equipped, and trailers in the ratio of three to two; that is, a five-car train will consist of three motor cars and two trail cars, the motor cars being cars 1, 3 and 5. An eight-car train, however, will consist of five motor cars and three trail cars; the motor cars being 1, 3, 5, 6 and 8, or else numbers 1, 3, 4, 6 and 8. By this arrangement it is possible to make up three-car trains consisting of two motor cars with a trail car between them, by simply taking off two cars from either end of a five-car train.

All the cars are equipped with the Westinghouse pneumatic multiple-unit system of control, and each motor car has two propelling motors of 200 horse-power each, both of which are carried on the same truck; that is, each motor car has a motor truck at one end carrying two motors, one geared to each axle, while the truck at the other end of the car is a "trailer" and carries no motive power. Both cars and trucks were designed by George Gibbs, chief engineer of electric traction for the Pennsylvania, New York & Long Island Railroad and for the Long Island Railroad, and were built by the American Car and Foundry Company and the Baldwin Locomotive Works, the cars being constructed by the former company and the trucks by the latter.

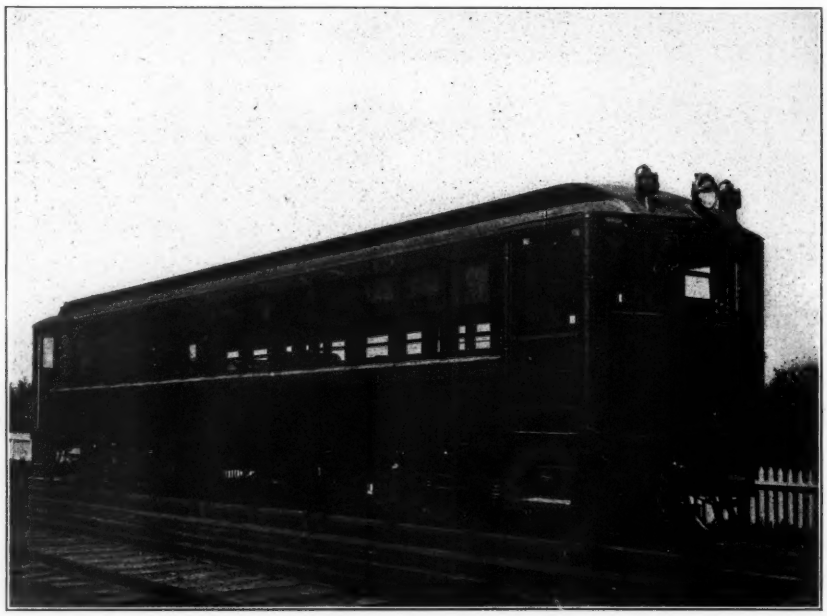
These cars are quite similar in appearance to the steel cars in use by the New York subway (which were also designed by Mr. Gibbs), being constructed throughout of steel and finished in aluminum. The problem of their design has been considerably simplified through the experience already gained with the subway cars. The requirements of the Long Island Railroad, however, necessitated the embodying of a good many special features in order to conform to the requirements of the service. For instance, all the conditions and limitations which applied to the New York subway, such as limited subway heights and clearances on curves, high speeds with frequent stops, maximum strength combined with smallest possible weight, etc., applied with equal force to the Long Island problem, since the Long Island cars were designed to interchange with the cars in the Manhattan subway. An additional feature presented itself, however, in the fact that trains, after leaving the city limits, had to run on the ground and let passengers on or off at stations whose platforms did not come flush with the platforms of the cars. This necessitated the design of a special combination platform which should be the full width of the car when running with-

THIRD-RAIL LAYOUT AT HIGHWAY CROSSING NEAR WOODHAVEN JUNCTION.

in the city limits, but which would provide for a pair of steps to be used when running on the surface of the ground.

These cars are now receiving their equipment at the shops of the Long Island Railroad, between Locust avenue and Springfield, on the cut-off line to Valley Stream. The shops have a capacity for the equipment of about ten cars per week, which are received from the builders in an entirely completed condition as regards exterior and interior finish, but are bare of any electrical apparatus. After receiving their electrical equipment they are given many trial runs before being placed in active service. Each motor-car weighs 83,000 pounds, and is capable of maintaining a maximum speed of fifty-five miles per hour and a schedule speed, including stops 1.6 miles apart, of twenty-five miles per hour.

A noticeable feature of their operation is the fact that, although attaining their maximum speed under very short headway, there is no jerk or jar experienced in the process, acceleration being accomplished very smoothly and evenly. The trains are brought to a stop in the same even manner, being equipped with specially designed air brakes controlled by the new Westinghouse graduated release triple-valve. In this respect the equipment is a great improvement over any electric trains hitherto tried.



Steel Motor Car, Showing Contact Shoe Protection.

INSPECTION SHEDS.

In order that the rolling stock of the road be kept to its full efficiency, large car-inspection sheds have been erected at Rockaway Park, Dunton and at the Morris Park shops. The one at Rockaway Park is 100 by 30 feet in size, the Dunton shed 200 by 50 feet, and the one at Morris Park 200 by 75 feet. These sheds are large enough to accommodate trains of eight cars and are fitted with all necessary tools and appliances, the pits being fitted with compressed-air pipes in order that pneumatic tools may be used under the cars.

Steel-Concrete House for Two Portable Substations, at Belmont Park.

ORGANIZATION.

When it was decided, three years ago, to electrify the system, Messrs. Westinghouse, Church, Kerr & Company were engaged to act as engineers and constructors for the road, the entire work being under the direction of Mr. George Gibbs, who acted first as electrical engineer of the road and first vice-president of Westinghouse, Church, Kerr & Company, and afterward as chief engineer of electric traction for the road, the general features of the work being under the supervision of the electrical committee of the road, composed of various officials. The construction work was under the supervision of George B. Caldwell, who acted as superintendent of that department.

Work was begun on the various sections as follow.. power-house, September 15, 1903, the first engine being put in operation January 6, 1905, and regular operation was commenced July 26, 1905. Work on the substations was begun May 24, 1904, and completed July 7, 1905; the substations being put into operation July 26, 1905. The transmission system was started November 30, 1904, and finished May 27, 1905, while work on the third rail and the bonding of the tracks was begun October 6, 1904, finished August 31, 1905, and put into operation July 26, 1905.

Observations of the Direction of Lightning Flashes.

Views held with regard to the nature of lightning flashes have been so discordant that Herr K. E. F. Schmidt has been led to make an investigation into this matter. He constructed an apparatus consisting of a disc ten centimetres in diameter, upon which was painted a white cross, the arms of which had a breadth of two millimetres. This disc was rotated by clockwork at from fifty to sixty revolutions per second. With it he has watched lightning discharges during a great number of bad storms, and has noticed the following different characteristics: first, many flashes cause the cross to stand out sharply and brightly. Second, frequently, two or three sharp images of the cross appear. Usually, one of these is the brightest, the others of varying intensity. The dying-out of these images usually indicates the direction of rotation of the disc, but sometimes apparently shows rotation in the opposite direction. Frequently, the image of the cross appears with broadened arms fainter on the edges; sometimes with two or three fine radial secondary branches separated by about five degrees. A brilliant flash, about forty-five degrees above the horizon, showed apparently eight images of the cross separated by equal angles. A fainter flash, vertical to the horizon, and about thirty to forty degrees high, produced a grey image of the cross. From these observations, the author concludes that lightning discharges may be of very different kinds. Those falling under the second classifications given above show that successive partial discharges may take place. In classification three above, it is shown that the duration of the flash must have been at least one one-thousandth of a second, while the flashes of the kind classified as four above, would indicate that there had been eight successive discharges, separated by about one-thousandth of a second. Flashes of the kind described in classification five lasted at least one two-hundredth of a second, while the flashes described in classification one could not have lasted for more than one thirty-five-thousandth or one forty-thousandth of a second.—*Elektrotechnische Zeitschrift* (*Berlin*), *September* 28.

BOOK REVIEWS.

"The Business of Municipalities and Private Corporations Compared." M. J. Francisco. Rutland, Vt. M. J. Francisco & Son. Paper. 136 pages. 3¾ by 6¾ inches. Supplied by the ELECTRICAL REVIEW at $1.

This is a new addition to the author's series dealing with municipal problems. In fact, it is a revision of Mr. Francisco's earlier book entitled "Municipalities versus Private Corporations." The author of this treatise commenced the investigation and study of municipal ownership in 1885. He owned and operated an electric light plant for twelve years, and then withdrew from the business. He endeavors here to furnish reliable facts relating to private and municipal plants. A large amount of data has been compiled, relating to municipal plants in this country, in each case the number of candle-power-hours furnished for one cent being given. This enables the performance of the municipal plants to be compared with that of private lighting plants, and is used to add force to the author's argument. He says the attempt of a municipality to supply its citizens with electric lights can be looked at from any one of three ways: first, if the lights are operated at less than cost, the taxpayers, as a body, are called upon to make up the deficit for the benefit of those who use the lights. If, on the other hand, the lights are operated at a profit, those who use them must pay the profit for the benefit of the body of taxpayers who would otherwise be compelled to provide the deficit. Thirdly, if run at neither profit nor loss, the municipality is undertaking the responsibility of a business enterprise which is not profitable nor beneficial, and by such plan, excluding citizens from a just right, and the city of the benefit of taxes that would be paid by a private corporation. The author believes that each of these propositions is unjust and inequitable. He holds that the true policy of a municipality is regulation, and not ownership, and that the former would give better results, without calling for any investment. The book should be of considerable interest to all who are interested in this important question.

"Modern Lightning Conductors." Killingworth Hedges. New York. The D. Van Nostrand Company. Cloth. 120 pages. 6 by 10 inches. Illustrated. Supplied by the ELECTRICAL REVIEW at $3.

This valuable addition to the literature of lightning protection is based mainly on the report of the Lightning Research Committee, of Great Britain. In fact, the author was the secretary to this committee. He gives in this work the report of the committee, including the introduction prepared by Sir Oliver Lodge. The author shows also wherein the new report differs from that of the former committee. The difference in the character of lightning discharges is brought out clearly, and it is shown how a proper lightning-rod may protect a building from damage due to a direct discharge from a cloud to the earth, and yet be practically worthless in the event of a discharge taking place between two clouds. The old idea, that a lightning-rod protected an area which is the base of a cone, having a radius equal to the height of the rod, is declared to be fallacious. This area of supposed protection has been made smaller and smaller, until finally it has been abandoned altogether. In chapter iv, methods of protecting buildings are discussed clearly. The most suitable type of terminal is shown, and the best methods of connecting the grounding wires and of supporting these from the building are described and illustrated. Copper is a better material for the lightning conductor than iron, since a smaller conductor may be used, and also since it is not as subject to corrosion. Iron has some advantages, however, since it has a higher resistance than copper. When used, the most suitable form is that of a galvanized stranded wire. To protect against the so-called B-flash—that is, the discharge taking place between a cloud and the earth when the charge of the cloud is released by a discharge above it—it is advised that a metallic cage be constructed around the building. While, in most instances, this cage will be more or less imperfect, it is still always advisable to carry a conductor along the ridge of the roof or around the eaves, and connect this to the ground by means of a number of vertical cables. The cables must be carefully grounded in moist earth. These general rules have been known for some time, but of late the lightning-rod has been under discredit. It is the aim of the author to show that this view of the lightning-rod is incorrect, and that it is a valuable protective device. The latter part of this book describes a number of important installations for protecting buildings against lightning. Notes are given on the practice followed in this country and in the various countries of Europe. The book concludes with a chapter on examples of lightning strokes on protected and unprotected buildings, these being taken from reports made to the research committee; and with a description of peculiar effects sometimes brought about by lightning. The interesting statement is made in one place, that insurance companies seem indifferent whether buildings are now protected against lightning or not.

"The Illumination of the Subway Stations."

TO THE EDITOR OF THE ELECTRICAL REVIEW:

In your issue of August 26 an article by Mr. E. Leavenworth Elliott, entitled "The Illumination of the Subway Stations," criticises the method adopted. The writer is in no wise responsible for the arrangement of the lighting of the subway, except in the design of the diffusing reflectors referred to in this article. The value of this reflector is seriously questioned by Mr. Elliott, but since this matter is dealt with fully on another page of this issue, it need not be taken up here. The engineers in charge of the lighting of the subway gave the fullest consideration to all available sources of light, with such adjuncts as appeared to be suitable. From these, after exhaustive tests, which included the Pagoda reflectors, selection was made to fulfil, in the best manner possible, the service of the public.

In this examination the following points were considered: first, satisfactory illumination; second, avoidance of injurious conditions to the eyes; third, reasonable economy.

In the article referred to above, the following statement is made: " . . . but in the present case there is less demand for such diffusion than in almost any other case of interior lighting, for the reason that with the exception of the employés the stations are only occupied for a few minutes by the same persons; and it is furthermore unnecessary to provide illumination for reading or other careful work."

With this as a premise, the present means of lighting is depreciated, and various changes are suggested which would result in uncomfortable intrinsic brightness. Yet it would seem that, granting this premise, the manner of lighting the subway is entirely justified, even when based on Mr. Elliott's curves. The curves presented in these figures consider in much detail the illumination of the *floor* of the stations, but in order to secure this desired illumination, the eyes of the passengers would necessarily suffer from the intrinsic brightness of the source suggested, when viewed from the average height of the eyes. This is assumed to be five feet three inches from the floor. It is obviously desirable to secure sufficient light, but it is not clear why more than a sufficing light should be provided. All that is required at the plane of the floor is for the passengers to see their way clearly. They should, however, be enabled to read newspapers

comfortably, and therefore it was determined to provide sufficing illumination at the plane at which the average reader is likely to hold a newspaper. This was taken to be four feet six inches from the floor, and all arrangements were based upon this.

An examination of the Rousseau curves of the reflectors now in the subway, and the one proposed by Mr. Elliott (all given in Fig. 6 of this article), indicates the following (see Fig. 1, page 697) : the curve for the ground-glass balls shows a well-distributed light, sufficing for general illumination, but not for reading except directly under each ball. The curve for the bell-shaped reflectors shows sufficient light for comfort for general illumination, this being the purpose for which they are intended. This gives excellent distribution, making a good general illumination, which is all they are called upon to do.

The curve for the prismed-glass diffusing reflectors shows a remarkably uniform distribution, securing directly beneath the light at the plane for reading more than two candle-feet. It gives a little less than one candle-foot four feet away, even if not reenforced by other lamps, yet here they receive not less than one-third candle-foot reenforcement from the three adjacent lamps. At eleven feet away from the lamp toward the centre of each group of four lamps, at the plane adopted for reading, the four lamps give each 0.105 candle-foot, making here available about one-half candle-foot. This may be considered the minimum lighting in the subway where the diffusing reflectors are used.

It is true that the so-called Pagoda reflector with a thirty-two-candle-power lamp gives up to forty-eight degrees higher intensity than the arrangement with the diffusing reflector; but beyond this it becomes rapidly less, while the curve for the diffusing reflector shows a well-sustained, equable illumination, sufficing, but not uncomfortably brilliant. It is probably correct that the Pagoda reflector gives sixty-six per cent more light in the sixty-degree zone, but, as a matter of fact, it falls below the subway reflector at forty-eight degrees, and thence rapidly to about six candle-power at ninety degrees. To have too much light at one point, and not enough at another, is not good lighting. The curve for the prismed-glass diffusing reflector shows, on the other hand, a maintained, although moderate, curve throughout from zero to ninety degrees. Such distribution is of value where general illumination is sought for, rather than the lighting of spots.

Illuminating engineers will insist that uniform lighting is preferable to a method of extremes. Further, exposed sources of high intensity are more injurious to the eyes than insufficient lighting.

A lamp of small candle-power, but of clear glass, will give the impression of higher candle-power than a lamp giving more light, but covered with a ground-glass bulb. When, however, an attempt is made to read thereby, it will be quickly discovered that the less intrinsically brilliant source with the ground-glass bulb or cover will enable one to read comfortably at the longer distance.

To maintain illumination throughout, up to a given desirable minimum with the clear prismatic-glass reflectors, requires a larger number of lamps to be used. This involves limited areas that will be uncomfortable and injurious to the eyes, owing to the too great intrinsic brilliancy which is given by this type of reflector. Further, should any lamp be accidentally extinguished, there will be greater inconvenience from alternate over-brilliant and dark areas. This effect is minimized where diffusing reflectors and globes are used, as all the adjacent lamps will contribute to lighting the space otherwise unlighted.

The Pagoda reflector gives a mean value of 40.3 candle-power for the seventy-five-degree zone, while the subway diffusing reflector gives only 36.2 candle-power. But the engineers of the subway, in their determination to protect the eyes of the public, have deliberately sacrificed ten per cent of the available light by covering the lamps with ground-glass balls. Without the ground-glass covers the illumination secured from the diffusing reflectors would have been at least equal to that of the Pagoda reflector, with, in addition, a superior distribution.

Ordinarily, frosted incandescent lamps would be used to avoid the intrinsic brightness of lamps with clear glass bulbs. The original cost of frosted lamps is twenty per cent greater than of clear glass. They give, at first, a reduced light of ten per cent and further rapidly deteriorate because of the accretion of dust, etc., on the frosting on the outside of the bulbs. Their lives are very considerably less than lamps with clear bulbs. Therefore, both as a matter of economy and efficiency, clear glass lamps were adopted, covered by removable bulbs or domes, frosted on the inside.

M. Allard, a French authority, estimates brilliant sunlight at the earth's surface to be equivalent to 5,350 candle-feet. Necessarily, in passing from such an illumination on the street to the subway, an impression is given of insufficient lighting by the sudden contrast; but if it were attempted to secure the equivalent of only four candle-feet (which is the minimum estimated room daylight illumination), it would be necessary to have lights of high intensity and great intrinsic brilliancy, with suitable appliances for diffusing and softening the light. This is entirely possible, but would not be economical; nor does it appear called for. Further, if, as proposed, the illumination of the *floor* of the stations is accepted as the standard, to secure the minimum equivalent of room daylight it would be necessary to install lights of 324 candle-power in the ceilings at nine feet height. Such an arrangement would give an illumination of twenty-three candle-feet at the height of the average eyes. Anything less than this might still give an impression of relative darkness to those coming from the street, and even this would not suffice to remove such impressions on a sunny day. The complaint that the subway gives the impression that it is darker than the streets, is not removable within economic limits, nor is there any valid reason for attempting it. In fact, it would be a bold illuminating engineer who would advocate this, or even the seven candle-feet at five feet three inches height from the floor, which would result if the suggestion presented in Mr. Elliott's criticism were adopted.

The illumination in the subway stations must not be considered final, for consideration is constantly being given to this matter. When a method is found which reasonably satisfies the conditions of comfort, efficiency and economy better than does the present system, action will probably be taken by the authorities. It is not dogmatically contended that the illumination in the subway stations is sufficient. If more light is really required, it appears that some additional lamps should be installed, of moderate power, rather than to replace the present system by lamps, reflectors, etc., giving the objectionable intrinsic brightness as proposed by Mr. Elliott. It is suggested that one additional lamp and reflector placed in the midst of each group of four would accomplish all that is required.

E. L. Zalinski,
Major U. S. Army (Retired).

Steel Cars for Suburban Passenger Service of the New York Central & Hudson River Railroad.

The steel cars to be used in the suburban passenger service in the New York electric zone are now being built by the American Car and Foundry Company, at Berwick, Pa. These cars will be used in trains made up of both motor-cars and trailers equipped with the Sprague-General Electric multiple-unit system of control. They are designed to operate around curves with a minimum radius of 135 feet.

The motor-cars and trailers are alike except for the motors and motor trucks, control apparatus and air-compressor.

The light weight of the motor-cars is 102,600 pounds and of the trailers, 78,600; the weight per passenger being 1,603 pounds and 1,228 pounds respectively. The weight of the usual sixty-foot wooden coaches used in steam service is about 61,800 pounds, or 965 pounds per passenger.

On account of eliminating the weight of the steam locomotive, however, the total weight of a six-car train is 39.4 tons less for the electric train than for the steam train.

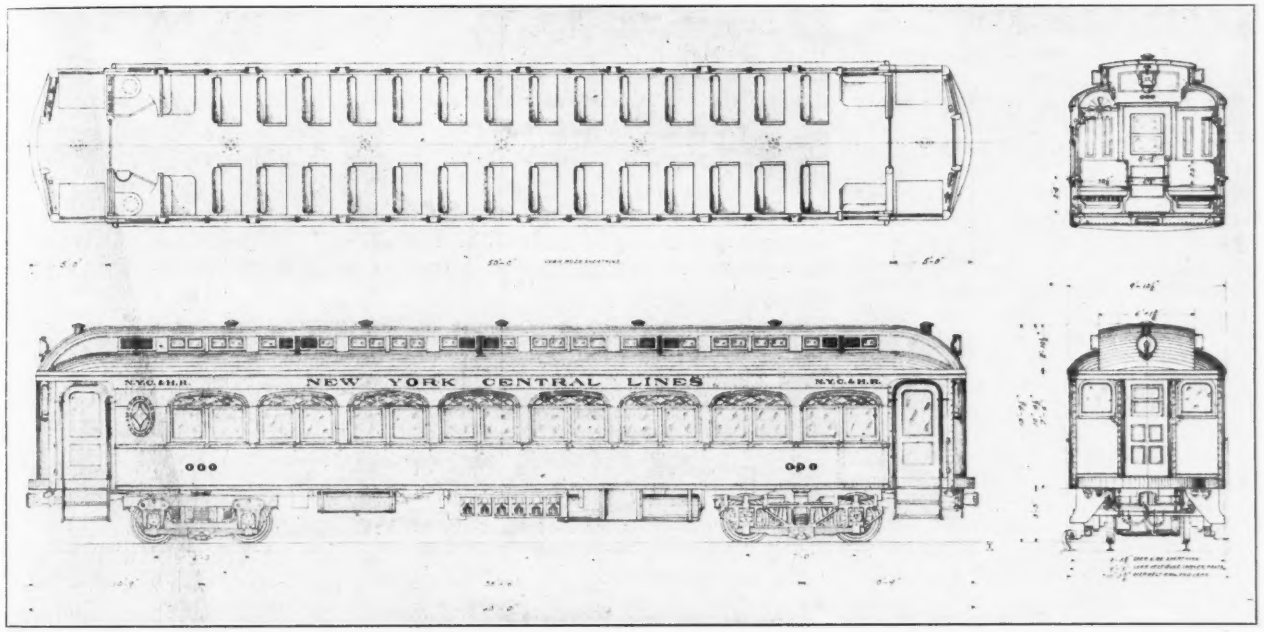
There are two 200-horse-power General Electric No. 69 C motors on the motor truck of each car. They will give an acceleration of one and a quarter miles per hour per second and a speed of fifty-two miles per hour.

The general interior arrangement of the car is similar to that of sixty-foot coaches used in steam service. The seats are set transversely and there are no side doors in the body of the car; at one end there are two seats, one in each corner. The vestibule platforms are five feet long and the full width of the car body. They are fitted with steps for use with low-station platforms, but the steps are covered with automatic lifting trap-doors for use with the high-station platforms which will be built in the electric zone in order to expedite the handling of passengers.

The vestibule side doors slide into pockets in the side of the car. The vestibule end doors leading from car to car, when open, swing into such a position as to enclose the motorman's air-brake valve and the control apparatus. The vestibule at the head end of the leading car forms the motorman's compartment.

The centre sills of the car-framing consist of two eight-inch I-beams, each continuous between platform end sills. The sides of the cars are built up as plate girders with the steel sheathing plates forming the web, a continuous six-inch by six-inch by one-half-inch angle, the bottom flange, and a continuous special bulb section at the belt rail, the top flange. The side posts extend in one piece from sill to plate. Three special cross-bearers, extending from side to side of the car under the sills and spaced between the body bolsters, act as floor supports and transfer to the sides of the car loads which would otherwise tend to deflect the centre sills. By this arrangement the centre sills are kept in alignment and retain their full value as compression members under buffing stresses. The end sills consist of steel channels. The ends of the car-body and the vestibule are built up of rolled and pressed steel shapes and steel plates. An anti-telescoping steel plate is secured under the centre sills and platform end sills. The buffer beam is made up of white oak faced with steel plate. The car-lines consist of steel angles in one continuous length from side plate to side plate, forming the contour of the lower and upper decks. The ventilator frames are of pressed steel. The roof is formed of fireproof composite board covered with heavy cotton duck.

Floor supports consist of steel angles set longitudinally and are supported by the cross-bearers. The flooring is made up of galvanized keystone section sheet steel laid transversely and covered with cement



STEEL CAR FOR THE SUBURBAN PASSENGER SERVICE OF THE NEW YORK CENTRAL & HUDSON RIVER RAILROAD.

These cars are constructed entirely of non-inflammable material, the frames and bodies being made up of structural steel and pressed steel shapes, the window and door casings and frames and the mouldings of pressed steel and the fittings of metal or fireproof material.

The principal dimensions are as follows:

	Feet.	Inches.
Length overall	60	
Length of car body between vestibules	50	
Width overall	10	2⅝
Width over sheathing and platform floor	9	8⅝
Height from top of rail to top of roof	13	9½
Total wheel base	45	
Wheel base of motor trucks	7	
Wheel base of trailer trucks	6	
Diameter of motor truck wheels		36
Diameter of trailer truck wheels		33

Seating capacity, 64 passengers.

flooring. This is protected with maple floor strips.

The interior finish consists of composite board head lining and plate steel relieved at joints and connections by rolled steel mouldings. Seats are of the walk-over type, upholstered in fireproof rattan. The fittings are of statuary bronze.

The cars are fitted with both Pintsch gas and electric light, the former being necessary on account of the cars being used in combined steam and electric service before the completion of the entire electrification work. There are five Pintsch gas lamps with four jets each and forty-two sixteen-candle-power electric lamps, thirty hung as pendents from the clear-story sills, fifteen on each side of the car and twelve hung in pairs over the aisle. Each vestibule has a Pintsch deck light and two electric lights.

Each end of the motor-cars is equipped with an incandescent headlight placed on the roof of the vestibule.

Systems for heating by either steam heat or electricity are also provided. The electric heaters are located under and attached to the seats.

An electric fan is located at each end of the car for cooling and ventilating.

The cars are equipped with high-speed automatic air-brakes, each motor-car being a unit in itself and having its own compressor and motorman's brake valve. The apparatus is so arranged that locomotives when coupled to trains can operate the system in the usual manner. A Lindstrom hand-brake is installed on each platform.

Each car is equipped with a complete air-signal apparatus, with air whistles in the motorman's compartments which can be cut out when a locomotive is attached.

The switch-panel chamber is located at the trailer end of the car on the same side as the control apparatus. The rear of the panel is accessible from the men's toilet room. This panel contains all the switches for the control of the car and for the air-compressor and lighting, heating and ventilating apparatus.

In addition to the ordinary brake, whistle and steam-hose couplings, there are two bus-line and two control train-line coupler sockets on each end of the car. All the cables under the car are carried through loricated conduits. The motor leads from motors to car-body are covered with spiral brass armor.

The trucks are four-wheel, swing-bolster type, built by the American Locomotive Company. The motor truck wheels have cast-steel spoke centres. An extended hub on wheels of motor trucks takes the gear which is shrunk on the hub. The wheels are keyed to the axles. The side frames of motor trucks are of cast steel and the end frames of steel angles.

The third-rail shoe beam is attached to the journal boxes.

The motors have nose suspension and each motor is provided with safety lugs cast on the shell, one on each side of the motor nose.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

DISCUSSION ON LIGHTNING ARRESTERS AT THE 200TH MEETING.

The 200th meeting of the American Institute of Electrical Engineers was held at the assembly rooms of the New York Edison Company, Friday, October 27, to discuss three papers on lightning arresters. One, entitled "Performance of Lightning Arresters on Transmission Lines," was presented in abstract by the author, Mr. N. J. Neall. It describes the method of registering lightning arrester operation by means of test paper as employed by the Westinghouse Electric and Manufacturing Company, and gives a large amount of data collected by a number of electrical transmission systems, situated in various parts of the country. The character of the puncture made in these test papers, which are inserted between the discharge points of the arresters, is believed to indicate not only that a discharge has taken place, but to show its character and thus give evidence of the suitability of the protective apparatus for the place it holds.

A paper by Mr. Julian C. Smith on "Some Experience with Lightning Protective Apparatus" was read in abstract by Mr. G. S. Dunn. It gives an account of the use of lightning arresters of the horn type on the transmission lines of the Shawinigan Water and Power Company, where they seem to have been of value.

Mr. Philip Torchio, in a paper entitled "Note on Lightning Arresters on Italian High-Tension Transmission Lines," described the Gola "series" arrester and the "water-resistance static-discharger" as they are used in Italy. In the opinion of the author, the best practice in Italy consists in placing horn arresters on the line at the station, making the ground connection through a water rheostat. A water-resistance static-discharger is connected to the lines before they enter the station and choke coils and ordinary arresters should be placed on the lines just after entering the building. The line itself should be protected where it branches by means of horn arresters.

The discussion was opened by Mr. P. H. Tomas, who said that we are making great progress in lightning protection. All arresters embody two essential features—an air-gap and an arc-interrupter. Non-arcing gaps are not operative on high-power circuits unless connected in series with a resistance to limit the short-circuit current. An important question to-day is what value should this resistance have. Mr. Neall's paper indicates that in many cases this resistance is about right, but in other cases it seems to be too large. The most interesting conclusion which we can form is that the most dangerous class of lightning which we have to deal with is the kind in which a comparatively small actual discharge strikes a line. In many cases in which the horn arrester has acted, there have been some poles destroyed. These severe strokes do not pass an indefinite distance on the line. In the first few hundred feet the worst effect is overcome and the discharge goes down the poles. A certain amount, however, which will keep the potential of the line up to the discharge point, passes to the nearest station. At the station it meets with arresters, which it can overcome, or can not, as the case may be. The conclusion is that we will have a great help in high-tension plants, where the lines are very long, if we can place arresters one, two or three miles from the station. At such places the arrester gets a chance at the discharge before it reaches the apparatus.

Mr. C. F. Scott spoke of the difference in practice regarding grounding a point of the system. Those who use a grounded neutral are of the opinion that that is the only safe way to operate. On the other hand, those who have operated without any point of the system grounded, regard the insulated system as the only way to operate, and would not think of grounding any point in their system. Two high-voltage plants have been mentioned in particular this evening, that of the Shawinigan Water and Power Company, where the practice is to ground the neutral wire, and the Missouri River Power Company, where the practice is to keep the system entirely insulated. Missouri River Power Company's plant has run continuously for service twenty-four hours a day, and seven days a week, carrying a fairly uniform load all the while. During the year they had only four or five disturbances on the high-tension system. There had been more interference on some 2,000-volt distribution lines. The question of protection of the poles on the line seems to be one of the most serious problems in regard to lightning protection.

Professor W. S. Franklin said the questions which confront us at the present time in connection with lightning arresters can only be answered by experiments on long-distance, high-voltage transmission lines. What we need to

know is the number of failures of lightning arresters, resulting in damage to the apparatus in the station, or damage to the pole lines. The results in Mr. Neall's paper do not seem to have any value of that kind. The plain choke-coil offers everything that physics has to offer in protecting a piece of apparatus from a lightning discharge, and directing a lightning discharge to ground over a proper path. The kind of resistance that is needed, not only for line discharges, but also to be used in series with a spark-gap, is a resistance which is selective in that it offers a comparatively low resistance for quick discharges, and a comparatively high resistance for a slow flow of current; that is to say, a skin resistance. He suggests the use of a series of three-foot pipes of terra cotta, painted with about two cents' worth of platinum chloride, spread out on a surface about six feet broad. In the same way the protection of pole lines might be improved if some kind of paint could be developed which would offer a comparatively high resistance, but still have an enormously better conductivity than wood.

Mr. W. H. Palchell, engineer-in-chief of the Charing Cross, West End & City Electricity Supply Company, Limited, London, said that his company, which is operating seventy miles of underground lines, had some trouble with surges when the plant was started. Siemens's horn arresters did not stop the trouble, because a discharge would form a bead on one horn and upset the calibration. By making the horns with nearly parallel sides and facing one with carbon the trouble was entirely overcome.

Mr. H. G. Stott said that lightning divides itself into two classes. One is a class which corresponds somewhat to the surging spoken of and which can no doubt be taken care of, and the other class corresponds to something like a ton of dynamite and can not be taken care of. The first case can be taken care of by improving the insulation of the line and apparatus so that it will be able to withstand these shocks.

Mr. H. C. Worth, replying to a question, said that the resistance used with one type of arrester is now made of carborundum sticks which do not change as do the graphite sticks.

Mr. Philip Torchio said that experience in Italy has been similar to that in this country. The generators and transformers are seldom damaged. But short-circuits throw the system out, and thus interfere with the service.

Mr. C. P. Steinmetz described the different effects produced in a system by lightning. One of these which has not yet been discussed and which comes under the classification of internal lightning is due to the consonance of the third, ninth and fifteenth harmonics, which thus cause a surging of the system with respect to the ground. Our knowledge of the phenomenon of lightning is not complete yet. If lightning were a very high-frequency oscillation, like the discharge of a Leyden jar, then we could protect the system against it by interposing reactive coils between the station and line, and shunt the discharge by multiple spark-gaps to ground. If lightning were a steady, gradual charge and discharge of the line, we could discharge the line by a high-resistance shunt toward ground, with or without a sparker. If it were a low-frequency high-power surging, we could endeavor to take care of it, but lightning is neither merely the one nor the other, nor the surging, but may embrace all three of these, or any two of the phenomena at the same time. Occasionally electrostatic disturbances in the lines originate in the atmosphere, consisting of a gradual, steady charge, followed by a very high-frequency, local-oscillating discharge, accompanied by a low-frequency surging. All three conditions occur at the same time, but there may be lightning disturbances different from all these three cases. Globular lightning has been observed occasionally sufficiently by observers and no question regarding its existence can be raised. It probably is not a sudden, instantaneous discharge, but a discharge centre, somewhat of the character of an arc discharge, but different therefrom. There is, however, one thing that we know regarding atmospheric disturbances. We know that in the interior of a conducting body of perfect conductivity there can be no electric disturbance produced by external disturbance; that is, if we enclose our transmission system in a perfectly conducting shell, as, for instance, by putting it underground, atmospheric disturbance can not enter in, and inversely, since we can not put our transmission line underground, if we bring the ground to the transmission line we will make the transmission line the more complete the more the ground resembles a perfectly conducting shell interposed between the transmission line and the atmosphere. A grounded overhead wire appears the most perfect protection of a transmission system against atmospheric disturbances. Two wires are more perfect than one wire, and three wires are more perfect still, as a conducting shell. In some cases when barbed wire is used for overhead wire for protection against atmospheric disturbances, it will give a much larger support by its more rapid action. This will be true in certain classes of atmospheric disturbances, but in other classes of such disturbances it has no advantage. But that does not mean that any so-called overhead wire grounded, as grounds are frequently made, means a protection. It is essential in perfecting a transmission line by overhead ground wire that the transmission line should be in the protective zone of that wire, that is, in the space enclosed by an angle of forty-five or preferably sixty degrees from the grounded wire downward. The conductivity of the grounded wire, although coming into consideration, is not very important; it is not material how large a grounded wire is used, when the grounded wire merely brings the ground potential above the transmission line and so lowers the electrostatic potential of the space where the transmission line is, that is the value which it would have unprotected, to a very much lower value corresponding to its position between the ground wire and the ground. In that case the resistance of the ground wire has no direct effect. But where the line is exposed to a secondary induced current resulting from a lightning discharge more or less parallel to the line, the transmission line is in the position of a secondary conductor to the lightning stroke and the ground wire in the position of a short-circuited secondary, which, by carrying a reversed current, screens the transmission line from electrodynamic induction more or less completely. The more completely, the lower the effective resistance of the ground wire is. That is, the protection of the transmission line against the entrance of atmospheric disturbance which will be more complete the more perfectly the grounded system represents a conducting shell of perfect conductivity. It can never be entirely complete and we still require apparatus at the station to protect the apparatus against the oscillating discharges, like the Leyden jar, or against accumulated discharges, and to protect against all the known characteristics of atmospheric disturbances, and unfortunately against those still unknown disturbances which may originate in the atmosphere.

Wire Cluster Decision.

In the Circuit Court of the United States, Southern District of New York, an opinion was handed down October 31, 1905, by Judge Holt in the suit of the Benjamin Electric Manufacturing Company against the Dale Company and John H. Dale for infringement of patents 721,774 and 721,777. These are the patents on the Benjamin wireless cluster, and the opinion holds that said patents are not infringed by the well-known Dale wireless clusters. The bill is dismissed with costs. The complainant was represented by Seward Davis, Esq., of New York, and Messrs. Jones and Addington, of Chicago; and the defendants by Messrs. Rosenbaum and Stockbridge, of New York.

Reviews of Current Engineering and Scientific Literature.

Notes on the Selection of Incandescent Lamps.

Considering the desirability, from an electric supply company's point of view, of meeting, in some way, the keen competition of the gas companies, Mr. J. E. Dawson thinks it advisable that the companies should pay more attention to the incandescent lamps used by the consumers. It is impossible for the average consumer to make any tests upon the lamps with which he is supplied in order to determine which, for his purpose, is the best—that is to say, which lamp gives the greatest number of candle-power-hours for a given price. The cost of lighting per candle-power-hour is determined by dividing the cost of the lamp by the number of hours for which it is used, and adding to this the average watts per candle, multiplied by the cost per watt-hour. But the consumer knows only two of these items—the first cost of the lamp and the rate he is paying for power. He must therefore depend upon some one else to guide him. Probably the most effective method of safeguarding the consumer and at the same time securing the best all-around results, would be for the various electric light companies to assume control of the maintenance and free renewal of consumers' lamps, but the author thinks it exceedingly doubtful whether the time is yet ripe in England for such a step. He thinks it would bring the lighting companies into conflict with the dealer in electrical supplies, while it is desirable that these two should be friendly. This method being unavailable, the author suggests that the electric light company test all of the makes of lamps available to its consumers, and thus determine the best. It could in this way keep a list of four or six makes of good lamps, and recommend these to the consumers. The records of the tests should be available to the consumers. The author proposes that if this plan can be adopted that the lighting companies undertake the work of testing as a part of their business; that they test the lamps in batches, purchasing them from the local dealers. The lighting companies should also keep in touch with the lamp-makers, so as to check the local price for lamps, and a fair price for each lamp should be given in the report of its performance. This plan has a disadvantage, since it does not ensure the breaking of lamps after they have passed their useful life; but the author thinks this can only be secured by the lighting companies adopting the free renewal plan.—*Abstracted from the Electrical Review (London), October* 13.

Concerning Tantalum Lamps.

Dr. W. Wedding gives here a detailed account of tests conducted on a number of tantalum lamps. Measurements were first made of the distribution of light about the lamps, which was found to be very regular. The curve showing this distribution consists of two nearly circular lobes. Then life tests were made of four lamps, and at the same time a number of standard carbon-filament lamps were run in order to obtain a comparison. The lamps tested were rated at twenty-five Hefner candles. These were compared with sixteen-candle-power and twenty-five-candle-power carbon lamps. The carbon lamps showed the well-known life characteristic, rising rapidly for a few hours after being put into service, and then falling gradually. The tantalum lamps showed a different life characteristic. The rise in candle-power when they were first put into service was very sharp, but was not as great as that of the carbon lamps. This was followed by a sharp decline of about one-third of the previous rise, and then the candle-power fell off, but at a less rate than with the carbon lamps. After about nine hundred hours one of the tantalum lamps broke, but the filament was rejoined by shaking the lamp until the two parts came in contact. At this point there was a slight rise in candle-power. After about 1,000 hours the second lamp broke, and the third lamp after about 1,100 hours. During this period the average candle-power of the four lamps was practically constant. There was then a slight rise in candle-power, and the fourth lamp broke after about 1,300 hours. After the first break, all of the lamps broke again a number of times, and this undoubtedly accounts for the rise in candle-power. One of the lamps broke about eleven times before it was put out of commission, and thus lasted altogether about 1,600 hours. Another lasted 1,850 hours, when, at the sixth break, it was thrown out. The third lamp lasted 1,900 hours, going out of service at the sixth break. The fourth lamp lasted 2,150 hours, going out of service after eleven breaks. Dr. Wedding then compares the cost of operating these tantalum lamps with that of the carbon lamps. The carbon lamps cost about half a mark (twelve cents). The tantalum lamps cost four marks ($1). The cost of power is taken as forty pfennigs (ten cents) per kilowatt-hour. It was found that the cost of lighting by means of the carbon lamps is less than that when using the tantalum lamps, for the first 270 hours. After this it is cheaper to make use of the tantalum lamps. The author shows how these costs are affected by the necessity of replacing the carbon and tantalum lamps as they burn out. The cost for lighting by means of the tantalum, however, remains less than that for the carbon lamp after the first 270 hours.—*Translated and abstracted from Elektrotechnische Zeitschrift (Berlin), October* 12.

Lancashire Electric Power Company's System of Generation and Distribution.

This is one of the power schemes now being developed in England for supplying a fairly large district. The entire system closely resembles that of the Yorkshire Electric Power Company, which was described briefly in the ELECTRICAL REVIEW for September 23. In fact, both systems have been designed by Mr. H. F. Parshall, and differ only as certain local conditions made desirable. The Lancashire company will furnish power to a district lying east of Liverpool, about forty miles long and ten miles wide, though of irregular outline. It is planned to build four stations. At present, the one at Radcliffe is the only one that has been started. The plot of ground available here was some twenty acres in area, situated on the river Irwell, and contiguous to the Lancashire & Yorkshire Railway. Abundant water is available for condensing. Coal is brought in on a railroad siding. The coal-handling apparatus is somewhat unusual. The cars are delivered by the road to a looped siding about seventy feet above the level of the power-house. An electric locomotive crane hauls the cars along this siding over the coal hoppers, and tips the coal into them. The empty car is then shunted to the other side of the loop. In this way the train of loaded cars is gradually emptied, and a train of empties is made up. The locomotive crane is equipped with two traction motors for hauling, and one thirty-horse-power motor for hoisting and tipping the trucks. It obtains its power from an overhead trolley wire, supplied with current at 220

volts. The coal is carried from the hoppers to the boiler room by means of a trolley car with a capacity of twenty hundredweight. This runs on a light railway into the boiler-house above the coal bunkers. The track is carried on light iron trestles, with a grade of about one in thirty-three, down to the station. The coal, after being discharged into the car, is weighed, the amount being automatically recorded. The loaded car is then released and runs down the track toward the power-house. At a certain point it hitches on to an endless rope controlled by a counterweight. The travel is continued until a tipping device, which may be fixed at any point, discharges the coal from the car into the bunkers. The weight thus being released, the car is returned by the counterweight to the coal hoppers above. From the bunkers above the boilers the coal is discharged to automatic stokers, it being weighed as used. The boiler-house at present contains six Babcock & Wilcox boilers, with superheaters and chain grates, the latter being driven by seven-horse-power electric motors. The boiler-house is seventy feet by eighty feet. The engine room is fifty feet by 100 feet long, and contains four 2,000-kilowatt Curtis turbo-generators. These generate three-phase current at 10,000 volts, fifty cycles per second. The system of distribution is practically the same as that of the Yorkshire plant, except that here there is less underground cable and more overhead work. Where a line passes from underground to overhead, or vice versa, a three-branched dividing box is used. This fits around and is sweated to the lead sheath of the cable. Within this box the three conductors are spread out and connected to three line wires, each carried out through porcelain bushings with corrugated sides. The opening in the bushing is then filled with an insulating compound, as is also the entire box. Power is being supplied from this station to a number of textile and other industries in the district.—*Abstracted from the Electrician (London), October* 13.

The Engineering of London Traffic.

The first report of the royal commission on London traffic was issued during the latter part of June. There are seven other volumes to this report, of which volume vii has just been issued. This constitutes the report to the royal commission on London traffic by the advisory board of engineers. The board consists of Sir John Wolf-Bary, Sir Benjamin Baker, and Mr. William Barclay Parsons. A brief extract of this report is here given. The volume itself contains over 160 folio pages. One of the first points made in regard to the condition in London is as follows: "The prime cause of London's backwardness is to be found in the lack of homogeneity in its municipal system and an entire absence of any centralized control and of consequent guiding effort which such control ensures." It would seem, therefore, that the first need toward solving the transport problem is a movement toward centralization of authority. In fact, the first volume of this report contained a proposal for the creation of a traffic board which would have the necessary authority to control these matters. As a means of seeing what can be done in London, the methods followed in other cities have been studied. Paris affords the most prominent instance of change. The transformation was commenced in 1858, and an immense sum has been expended. Since 1871 the expenditure in Paris on new streets has been over $120,000,000. Full data are given concerning the movement of vehicles and persons in London. Taking the whole day through, about seventy-one per cent of the passenger traffic into the central area is by rail; a little over fourteen per cent by street car, and about fifteen per cent by omnibus. The figures for going from the central area are somewhat different. The total local yearly traffic in Greater London is 1,164,000,000 passenger journeys. This includes local lines only. Taking the figure for the last census, it is found that the average yearly rides per passenger number 170, a figure which shows the defective accommodation of the city. The corresponding figures for Paris are 200; Berlin, 250, and New York, 300. These figures do not include the London cab traffic, which is important. Observations made on the question of speed travel show that traction engines travel at two miles an hour; heavy vans at two and one-half miles at the rush hours, and three miles at other times. For other vehicles the figures are as follows: light vans, four to six and six to eight miles; horse omnibuses, three and one-half to six, and five and one-quarter to eight miles; motor omnibuses, six and one-half to eight and one-quarter, and eight and one-half to eleven and one-half miles; horse cabs, three and one-half to six, and six to eight and one-half miles; motor cabs, eight and twelve miles; electric cars, five and one-half to seven, and eight and one-half to eleven and one-half miles. These figures refer to the central area, and they illustrate forcibly the need for dividing traffic, which means wider streets. They also show the desirability of further regulation of traffic by the police, so that slow traffic may be compelled to keep to the curb. At the present time any vehicle moving faster than a walk claims the right to the centre of the street, although it may be going much slower than a number of other vehicles on the street. The report shows that the average speed of motor omnibuses compares favorably with that of the street cars, and is naturally faster than that of the horse-drawn omnibuses—a result with which the abstractor does not agree, as the number of stops made by street cars to take on and let off passengers considerably reduces the running speed. This is particularly true with regard to the double-deck cars in use. The abstract then considers the value of adopting the policy proposed in the report of the commission, and endeavors to show that while the outlay of $150,000,000 for improving and widening streets is a large sum, it would still be an excellent investment for the city. The greater part of the burden of this expenditure would fall on the merchants of the city, yet it is they who will profit most by the expenditure. The report says that the average time required to travel ten miles from the various London termini is forty minutes, and adding ten minutes at each end of this for walking, brings the time per day spent in traveling up to two hours. It is difficult to estimate how much this would be reduced by the formation of the new streets proposed and the other facilities for traffic. Probably the reduction would not be great, but the greatest gain will be in the ability to move about quickly in the city.—*Abstracted from Engineering (London), October* 13.

The Electrical Trades Exposition Company's First Annual Electrical Show.

The Electrical Trades Exposition Company's first annual electrical show will be held at the Coliseum, Chicago, Ill., January 15 to January 27, 1905. The general admission will be fifty cents for adults and twenty-five cents for children.

Mr. Thomas R. Mercein is the general manager of the exposition company, 464 Monadnock Building, Chicago, Ill. During the show and for three days prior thereto the general manager or his representative will be in his office at the Coliseum.

Methods of Getting New Business.

A department devoted to the commercial development of Central Stations. Managers are invited to contribute suggestions for methods of increasing the demand for electric service.

Last week there were reproduced several of the advertisements placed by the Edison Electric Illuminating Company, of Boston, Mass., in the Boston newspapers. A word was said as to the reasons for the use of preferential space and for the selection of certain issues of the daily newspapers.

Another point which might be mentioned in connection with this Boston advertising is the consistency with which some peculiar expression is brought out. For instance, one advertisement closes with the interrogation, "Have you learned to be power-wise?" another, "Have you learned to be light-wise?" still another, "Have you learned to be sign-wise?"

"Power-wise." "Light-wise." "Sign-wise." In every advertisement some change in this expression is made use of. By and by the reader becomes familiar with the expression, and looks for it in the advertising. A characteristic of this nature alone often attracts more attention than even the make-up of the advertisement.

Is Your Home Wired for ELECTRIC LIGHT?

If not, the Edison Company will help you to have it Wired, so that you can enjoy the incomparable conveniences and advantages of ELECTRIC LIGHT in your home at comparatively little outlay.

How We Will Help You To Wire Your Home.

IT often happens that to Wire an entire residence from cellar to attic involves a considerable expense—more than the householder feels like paying, or is in a position at the moment to pay. If, however, the less important rooms are eliminated from consideration and the *living rooms*—those rooms in which an Electric service would be the biggest boon to you—dining room, kitchen, front and rear parlors, main halls, etc., are Wired, then the expense of Wiring is comparatively small, and well within the means of the average Brooklynite.

The Edison Company has, by competitive bids and after close figuring, made arrangements with certain wiring contractors, whereby for

Ninety-five Dollars

you can have your home Wired and equipped for Electric Lighting, as follows:

Dining Room	1 Outlet, 2 Lights.
Basement Hall	1 Outlet, 1 Light.
Cellar	1 Outlet, 1 Light, including 1 Switch.
Kitchen	1 Outlet, 1 Light.
Rear Parlor	1 Outlet, 3 Lights.
Main Hall	1 Outlet, 1 Light, 1 Flush Switch.
Parlor	3 Outlets, 3 Lights, including Base Receptacle.

This price covers everything you will be called upon to pay for this installation, including Electroliers and Glassware of suitable patterns. There are no extras. If you desire more Lights than provided for in this plan, you can secure them at approximately proportionate cost.

The cellar switch enables you to light the cellar from the kitchen floor and extinguish the light after you return therefrom. You thus always enter and leave a lighted cellar. Of course, you understand that with current from any of these outlets you can run an electric fan or heat an electric flatiron or water boiler, coffee pot, chafing dish or the like.

By this arrangement you can enjoy at once an Electric service with all that it means in the way of health, comfort, convenience, conservation of eyesight and the additional "tone" to your home; and if later on you desire to extend the service to other parts of the house, this may easily be done, as the installation is effected on the three-wire feeder system, so arranged as to permit of extensions with economy and expedition. Moreover, under improved modern methods of wiring, the work can be done with no injury to decorations and little inconvenience to the household.

Partial Payments if You Wish.

If it is inconvenient just at this time for you to expend the $95.00 in a lump sum, we will finance the deal, and you can pay us back in twelve monthly installments (covering a period of one year) without interest. As for the actual

Cost for Electric Lighting

you will find that, in spite of its immense superiority, under rates reduced by forty per cent. since January 1, 1905, Electric Light is now practically

As Cheap as Gas.

The above is the new Edison proposition for Wiring Brooklyn residences. The rest is "up to you." Do you want to be up-to-date? Do you care to have your home as convenient and comfortable for you and yours as you can make it? You would consider it poorly equipped without modern sanitary plumbing, with no better heating system than was used twenty years ago, with a well in the front yard instead of a connection with the city water.

None of these things is more essential or more truly effective for health and comfort than Electric Light, which requires no matches, has no open flame, does not consume oxygen or pollute the air, is a balm to tired eyes, and sheds a golden refulgence that is the acme of ideal illumination, at the same time adding a new element of beauty and elegance to the home.

If you would like to have this beneficent Lighting and Power service in your home, let us hear from you. A simple method of communication is to tear off the Coupon in the right hand lower corner of this page, fill in your name and address and mail to us. You will receive prompt response from an intelligent representative, who will be glad to furnish further details and talk the matter over with you. By acting promptly your home can be Electrically Lighted for the holidays.

Edison Electric Illuminating Co. Of Brooklyn,

360 Pearl Street, Brooklyn.

Telephone Call, 4640 Main.

RETURN COUPON.

Edison Electric Illuminating Co. of Brooklyn,
360 Pearl Street, Brooklyn.

Please have your representative call and see me with reference to the wiring of my residence for Electric Lighting.

Name .....

Address .....

Convenient time to call .....

A Full Page Newspaper Advertisement.

Speaking of newspaper advertising, the Edison Electric Illuminating Company, of Brooklyn, N. Y., has burst forth as a user of large space. For several days throughout the week the third page of several of the highest-class publications in the home city has been used. In one instance a full page was occupied, a reproduction of which is given herewith. The following day the upper right-hand corner of the same page was secured. The advertisement calls attention to, and lays stress upon, one proposition—the wiring of the house for electric light. These advertisements are excellent examples of how much can be said in a comparatively small space. There are several arguments made, and it is hardly possible for a reader to take up this paper and not become interested in the proposition that the Brooklyn company sets forth. Incorporated in each advertisement is a return coupon which can be made use of by the prospective consumer in forwarding an enquiry to the company. These enquiries are followed up by personal solicitation and special letters.

Wiring for Electric Light.

It often happens that to wire an entire residence from cellar to attic involves a considerable expense—more than the householder feels like paying, or is in a position at the moment to pay. If, however, the less important rooms are eliminated from consideration and the **Living Rooms**, those rooms in which an electric service would be the biggest boon to you, dining room, kitchen, front and rear parlors, main halls, etc., are wired, then the expense of wiring is comparatively small, and well within the means of the average Brooklynite.

The Edison Co. has, by competitive bids and after close figuring, made arrangements with certain wiring contractors whereby for

NINETY-FIVE DOLLARS

you can have your home wired and equipped for Electric Lighting as follows:

Dining Room, 1 outlet, 2 lights. **Kitchen, 1 outlet, 1 light.**
Basement Hall, 1 outlet, 1 light. **Rear Parlor, 1 outlet, 3 lights.**
Cellar, 1 outlet, 1 light, including 1 switch. **Main Hall, 1 outlet, 1 light, 1 flush switch.**
Parlor, 3 outlets, 3 lights, including base receptacle.

This price covers everything you will be called upon to pay for this installation, including electroliers and glassware of suitable patterns. There are no extras.

If you prefer you can pay the $95 in twelve monthly installments, without interest.

If you are interested fill out the annexed coupon and mail to us. An intelligent representative will call on you at once.

RETURN COUPON.

Edison Electric Illuminating Co. of Brooklyn,
360 Pearl Street, Brooklyn.

Please have your representative call and see me with reference to the wiring of my residence for Electric Lighting.

Name .....

Address .....

Convenient time to call....

EDISON ELECTRIC ILLUMINATING COMPANY OF BROOKLYN,
360 Pearl Street, Brooklyn.
Telephone 4640 Main.

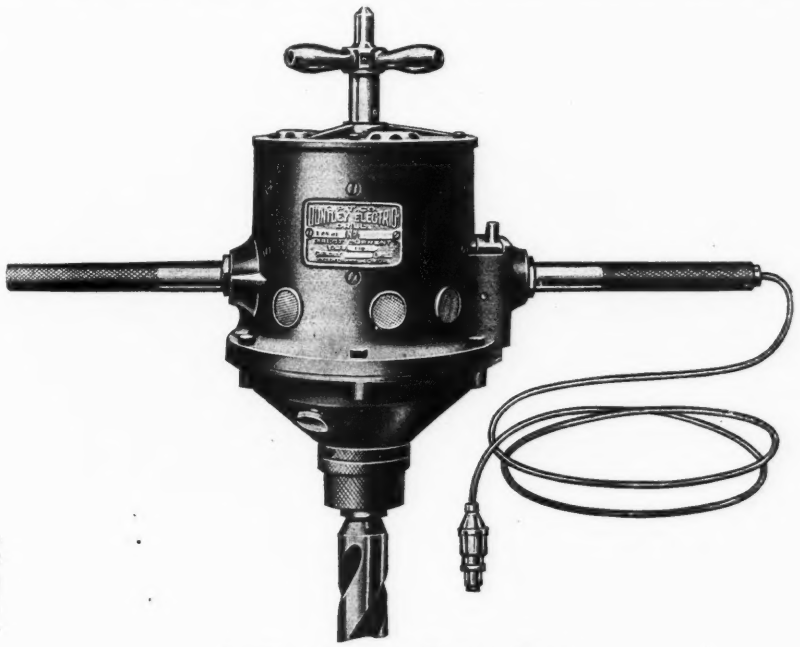
The Same Advertisement, Three Columns, Eight Inches.

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

Air-Cooled Duntley Electric Drills.

The air-cooled Duntley electric drills, manufactured by the Chicago Pneumatic Tool Company, Fisher Building, Chicago, Ill., are adapted to a wide range of usefulness, and may be used to advantage in machine shops, plumbing establishments, hotels, office buildings, apartments, and all manufacturing establishments where drilling or boring is required. The drills have passed through an experimental stage extending over a period of several years. They have been tested under all actual working conditions to which air drills are subjected, and hundreds are now doing service of every description, with excellent results.



AIR-COOLED DUNTLEY ELECTRIC DRILL.

The tri-motor drill has embodied in its construction ideas which are unique and of great practical value. By means of three motors located in a single housing, the maker is enabled to provide a new winding for the field coils, which ensures each motor running at the same speed, and through the method of gearing adopted there has been produced a powerful portable electric drill.

The motors are wound for standard voltages, and are used on direct-current circuits. Wherever the circuit is of the proper voltage, the drills may be connected to an ordinary incandescent lamp socket.

The larger-capacity, single-motor drills are provided with a friction clutch, and when shipped the clutch is set to slip at any time the drill may be cutting at a speed requiring an amperage in excess of the rating of the motor. The slipping clutch permits the motors to run at full speed while the drill spindle stops, thus preventing the blowing-out of the fuse plug, which has been provided as an additional safeguard against damage through overloading the motors or by allowing the drill to stick. When the drill sticks, allowing the friction collar to slip, a slight turn of the feed screw to release the pressure on the drill will cause the friction collar to again take hold and start the drill spindle rotating. This feature renders the machines safe, even in the hands of inexperienced operators. There is also eliminated the possibility of damage occurring through feeding the drill too rapidly. The switch is located at the base of the handle, and is operated easily and quickly by a thumb pressure.

The drill shown in the accompanying illustration is equipped with three motors, and is adapted for drilling in steel one and three-quarters and two and one-half inches. This drill consumes from six to nine amperes, 110 volts. The consumption is about half this when wound for 220 volts.

Double-Joint Desk Fixtures.

The accompanying illustrations show a new line of double-joint desk fixtures placed on the market by McLeod, Ward & Company, 27 Thames street, New York city. As the name implies, there is a double-joint movement near the base, and a single-joint movement at the socket, enabling a light to be placed at any point desired within the range of the fixture without loosening or tightening screws. The joints are so constructed that they may be moved freely without straining or in any way injuring the flexible plate which is concealed in the tubes.

DOUBLE-JOINT DESK PORTABLE.

One style of these fixtures is arranged with two brass clamps, which can be fitted over a roll-top desk and then tightened in place, making a perfectly rigid fixture. Another style is arranged with a back clamp similar to that used on the Kinsman desk lamp, which has an adjustable front clamp.

WITH ADJUSTABLE-JOINT CLAMP.

FOR ROLL-TOP DESK.

The fixtures are all fitted with telescoping tubes similar to those used in the well-known Kinsman desk fixtures. This makes them suitable for small or large desks. These fixtures are well constructed, and with the old line of desk fixtures manufactured by the company cover the lighting field pretty thoroughly.

Car-Lighting Storage Batteries.

The National Battery Company, Buffalo, N. Y., has devoted considerable time and labor to the perfection of an electric storage battery for use in connection with the electric-lighting systems of railroad trains. The company has placed upon the market batteries for car lighting which are stated to possess features of extraordinary merit. The material used throughout in the construction of these batteries is of the best, and the finished product is the result of skilled workmanship, under careful supervision. The batteries are in every respect reliable, and combine strength and durability with maximum capacity.

POSITIVE GROUP.

NEGATIVE GROUP.

The plates are assembled in hard-rubber jars contained in hardwood trays. Where suspended, these trays are provided with porcelain rollers and insulators. The method of assembling used makes a cell that is particularly desirable for portable purposes. The round post strap is not only a strong form of connection, but as the post is slightly larger at its base, the two-hole cover drops down over the post until it reaches a point where it fits snugly and tightly, thus preventing spilling of the acid. The point of connection of the lugs to the straps is reenforced by special burning. This gives additional strength where needed to resist the strains caused by the vibration of the cars, and the hard usage to which the cells are sometimes subjected.

REENFORCED CAR LIGHTING JAR.

The plates are separated by both ribbed wood and perforated rubber separators, permitting free circulation of the electrolyte, and effectually preventing short-circuiting of the plates. Each cell in the tray is connected to its neighbor by a lead strip and bolt connector. Any cell can thus be readily taken out and placed back in the tray.

The rubber jars are so constructed as to be particularly adapted to withstand breakage. The hard-rubber bridge in the bottom is provided with a soft-rubber lip on the upper edge, that acts as a cushion upon which the plates rest.

The battery plates are of the standard "Unit Accumulator" type. In the positive plate (of Planté formation) the units, or active portions, are hung in an antimoniated lead frame, and are lead-burned to it at the top, giving a perfect contact. The lead grid has a sufficient percentage of antimony to give it great rigidity. The plates will not buckle, because the expansion of the active portion which takes place in service is provided for by allowing ample free space between the units and the conducting frame.

The negative plate is of the Faure, or pasted type. This plate also has an antimoniated lead frame, and because of the large amount of active material held in reserve, the plate has a high and maintained capacity, with corresponding long life. These plates have low internal resistance, and the bevel-shaped ribs hold the active material in place throughout the life of the plate.

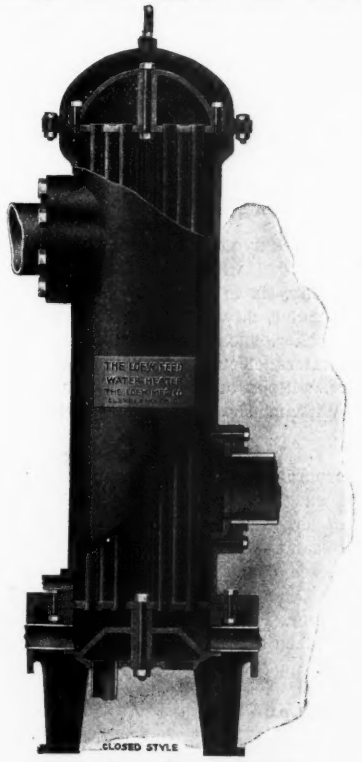
The Loew Feed-Water Heater.

The Loew Supply and Manufacturing Company, Cleveland, Ohio, has placed on the market a new form of feed-water heater. When heating water in a tube, the centre or core will not heat as rapidly as the outer surface of the water. With this fact in mind, the Loew feed-water heater has been constructed so that when the water traveling through the tube reaches the several ports at the top and bottom of the various sections of tubes, the course of the water is entirely changed, thoroughly mixing the water and equalizing the temperature.

This feed-water heater is also arranged so that the water passes six times through the exhaust steam, receiving the highest possible amount of heat. The several ports which thoroughly mix and equalize the temperature of the feed water also accomplish another purpose; they render

fittings unnecessary, so that friction caused by circulation is reduced to a minimum. Ample space for expansion of the water after heating is allowed, so that friction from this cause is avoided, and the capacity of the heater maintained.

Referring to the illustration, the cold water enters the first section through the inlet, and is carried to the double port at the top of the heater, where its course is changed. It then passes down the tubes in the second section, through a passage to the port at the bottom. This repeats the mixing and equalizing of the temperature. The water then travels up the tubes in the third section to another double port at the top, which again mixes it, continuing down the tubes in section four to another port, repeating the mixing of the heating water and sending it through the tubes in section five to a final double port, where the temperature of the water is thoroughly equalized. The water then passes through the tubes in section six to the outlet. The cold water is received on one side, and the hot water discharged on the opposite side. The distribution of the ports is so arranged that the expansion is equalized, preventing undue strains.



LOEW FEED-WATER HEATER.

The heater is built of heavy cast iron and brass, the outer shell, legs and caps being of cast iron. The tubes are of straight, seamless brass. Both ends of the tubes are rolled into tube plates, the bottom tube plate being bolted to the casing at the bottom of the heater, making it stationary. The top tube plate is loose and free from the outer shell, so that the tubes have ample room to expand when hot.

The heater is provided with hand-hole plates at the bottom, so that it may be cleaned easily. The top heads are easily removable, and the bottom may be unbolted and dropped down when an open surface of the tube is desired for cleaning. The complete cleansing of the heater can be accomplished in a short time.

The manufacturer claims the following advantages for this heater: it has a large heating surface. The water has a long exposure to the heat. It is simple in construction. Care has been taken to prevent unequal expansion or strain at any point.

Spiral Lamp Guard.

The accompanying illustrations show a new form of spiral lamp guard manufactured by the S. H. Couch Company, Incorporated, 156 Pearl street, Boston, Mass. The illustrations plainly indicate the method of attaching this lamp guard. The lamp is inserted, the smaller end first, between the largest convolutions of the spiral, and after the other convolutions have been fitted about the lamp, the tip of the bulb is placed in the eye of the guard. These guards are put up each in a four-inch by four-inch manila envelope, three dozen in a standard package, and six gross in a barrel.

METHOD OF APPLYING SPIRAL LAMP GUARD.

SPIRAL LAMP GUARD.

"Noscru" Midget Push-Buttons.

The "Noscru" midget push-button, an illustration of which is shown herewith, has met with remarkable success throughout the country. Contractors in general have taken to this device with a good deal of unanimity, as it combines a number of features which render it very attractive. The easy method of making connections with this button, eliminating entirely the use of screw connections, and the substantial construction, have made it a desirable specialty. The button has a yielding frictional contact, and is made entirely of porcelain and metal.

"NOSCRU" MIDGET PUSH-BUTTON.

Contractors throughout the country will be pleased to learn that the American Electrical Novelty and Manufacturing Company, New York city, has made arrangements with the Sarco Company, of the same city, to take the entire output of its factory, for the manufacture of these "Noscru" midget push-buttons. The American Electrical Novelty and Manufacturing Company will hereafter be the sole selling agent. One of the chief advantages to contractors of this new arrangement is that the push-buttons will be available throughout the world, because of the extensive connections of the American company, both at home and abroad.

Manila Electric.

The first annual statement of the Manila Electric Railroad and Lighting Corporation for the year ending September 1, 1905, is as follows: net earnings, $273,580; interest charges, $123,028; surplus, $150,552.

J. G. White & Company, which built and operated the plant, says in connection with this report, that while it is an annual one, the earnings up to April 10 were only from the sale of current for power and lighting purposes, as it was not until that date that the street railroad was opened to the public. There is still considerable work to do before the railway and lighting system will attain its maximum efficiency, and up to the present time the full mileage of the railway lines is not in operation.

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

COMBINATION LIGHTING PLANTS—A combination of the electric lighting plants and electric railways in the vicinity of La Crosse, Wis., is said to be in contemplation. The properties involved are announced as the La Crosse Railway Company, the Wisconsin Light and Power Company, the La Crosse Gas and Electric Company, and the proposed La Crosse & Black River Railway. It is purposed to transmit power from a large power plant on the Black river, near Black river falls.

TENNESSEE POWER COMPANY INCREASES ITS CAPITALIZATION—Following the letting of the contract for the concrete work of the lake and dam for the power plant to be erected at Hale's Bar, in the Tennessee river, the Chattanooga & Tennessee River Power Company has applied for an increase in the capital stock from $3,000,000 to $3,500,000. This is for the purpose of increasing the capacity of the power plant. According to the original plans the company was to erect a plant which would have a capacity of 36,000 horse-power. It is understood that this will now be increased to 50,000 horse-power.

NEW POWER COMPANY FOR ATLANTA, GA.—A mortgage deed has been filed in the clerk's office at Atlanta, Ga., by the Southern Light and Power Company, to the Knickerbocker Trust Company, of New York. The mortgage is given on certain property owned by the company in Fulton and De Kalb counties, for the purpose of issuing $500,000 worth of bonds. The Southern Light and Power Company was organized in Delaware, but has a place of business in Atlanta, Ga. In the mortgage deed it is stated that in future the company will be known as The Light Company. T. J. Kelly, of Atlanta, is named as president and W. A. Carlisle as secretary. The bonds will be issued for the purpose of erecting an electric power plant in or near Atlanta, to furnish power to Fulton and De Kalb counties.

TOLEDO TELEPHONE DEAL—The Toledo group of capitalists, which for the past two years has been active in securing telephone properties, has recently secured two new companies by the purchase of controlling interests in the Indianapolis Telephone Company and the new Long-Distance Telephone Company, of Indiana. The first-named property, which is an independent plant, has in operation about 13,000 telephones in Indianapolis and Marion County. It has a capital of $1,750,000. There are outstanding a bond issue of $800,000 five per cent securities, $10,000 of six per cent preferred stock, $400,000 guaranteed six per cent stock and $400,000 common stock. The new long-distance company has 3,600 miles of metallic circuits, and is the largest independent long-distance system in Indiana. It has a stock issue of $753,000, and a bond issue of $171,000 of five per cent long-time securities. The Toledo parties interested are James S. Brailey, Jr., H. R. Ashbrook Company, M. G. Bloch, Secor & Bell, Willard F. Robinson and Clarence Brown.

NEW LIGHT COMPANY ORGANIZED—The Stanislaus Electric Power Company has been organized in San Francisco with a capital of $10,000,000. There has already been subscribed some $6,000,000. The financiers of the new incorporation are Tucker, Anthony & Company, of Boston, Mass., and the Knickerbocker Trust Company, of New York. Mr. B. Thompson, of San Francisco, was the organizer of the company, and Leopold Wallach, of New York, is understood to have interested eastern capital in the enterprise. Both Mr. Wallach and Leopold Michels, president of the San Francisco Coke and Gas Company, are heavily interested in the new power company. The company has been organized to furnish San Francisco with electric power, and will probably be allied with the San Francisco Coke and Gas Company. It is understood that work has already been commenced on the middle fork of the Stanislaus river. The plans of the company call for 30,000 electrical horse-power, and in addition to that, water power equivalent to 20,000 electrical horse-power. Two large storage reservoirs are to be built which will take in about 1,500 acres. Enough timber land is to be purchased to provide for the lumber necessary in the construction of flumes and buildings.

NEW MANUFACTURING AND CONSTRUCTING COMPANIES.

NEW YORK, N. Y.—The Hall Telephone Manufacturing Company has been organized with a capital stock of $50,000.

OSSINING, N. Y.—The Hutchinson Electric Horn Company has been incorporated with a capital of $20,000. The directors are P. J. Pierson, Ossining; M. R. Hutchinson, W. M. Williams, New York.

ALBANY, N. Y.—The J. & M. Electric Company, of Utica, has been incorporated with a capital of $900. The directors are: Montgomery H. Johnson, Walter H. Morton and Henry G. Hatfield, of Utica.

WILMINGTON, DEL.—The Electrical Instrument Testing Company has been incorporated to manufacture and deal in electric motors and dynamos, and to inspect electrical instruments. The capital is $50,000.

COLUMBUS, OHIO—Robert L. Bruce, J. B. Addison, George C. McKeever, Louis G. Addison and Charles E. Munson have incorporated the Bruce Electrical Company with a capital stock of $25,000. The directors of the company are: F. H. Lindenberg, C. E. Munson, R. L. Bruce, J. B. Addison and George C. McKeever. R. L. Bruce was elected president and general manager; F. H. Lindenberg, vice-president; J. B. Addison, secretary and treasurer, and G. E. McKeever, superintendent of construction.

ALBANY, N. Y.—Articles of incorporation have been filed with the secretary of state by the Kent Light Company, of the village of Patchogue. It proposes to manufacture and sell gas, oil and electric light fixtures. The capital stock is placed at $250,000, consisting of shares of $100 each, and the directors for the first year are: Francis H. Van Vechten, of New York city; Frederick McChoate and Frank H. Fairfield, of East Orange, N. J., and A. H. Kent, Sr., and Thomas F. Kent, of Newark, N. J.

PETERSBORO, ONT.—The Pre-Payment Electric Meter Company, Limited, has been incorporated with a capital of $100,000. The primary object of the company is to place on the market the Gowlland pre-payment electric meter, of which it owns the patent for the Dominion. Other branches, such as the manufacture of electric meters, motors, transformers, electrical fans and all descriptions of electrical contrivances, will be taken up at a future date. The officers are: president, William Hamilton; vice-president, J. H. Larmouth.

ATTICA, N. Y.—A new corporation has been organized by the citizens of Attica, to be known as the Attica Home Telephone Company, for the purpose of erecting a telephone system and exchange and connecting the same with the several towns and villages of Wyoming and Genesee counties and with the several independent toll-line telephone companies. George T. Loomis, Clarence H. Beane, W. A. Joiner, Elon P. Spink, Hugh Miller, Carlton D. Wing and Henry B. Flach are the directors. The capital stock of the company is $10,000.

PERSONAL MENTION.

MR. ARTHUR WARREN has resigned his position as manager of publicity for the Allis-Chalmers Company, and will sail for Europe, on a journalistic mission, about the end of November.

MR. PETER COOPER HEWITT sailed on Tuesday, October 24, on the Kronprinz Wilhelm for Europe, where he will devote some time to visiting various centres of scientific and industrial interest.

MR. A. BRUCE SMITH, superintendent of construction of the Great Western Telegraph Company, Toronto, Ontario, has been appointed manager of telegraphs for the Grand Trunk Pacific Railway.

MR. S. W. STEARNS, Buffalo, N. Y., has been appointed manager of the Bell Telephone Company's Twin City branch, succeeding Mr.

William M. Conzelman, who has been transferred to the Buffalo office.

MR. HENRY C. HAZZARD, New York city, has been appointed secretary of the state commission of gas and electricity. Mr. Hazzard, who is a lawyer, was secretary to the police commission under Mayor Low.

MR. JAMES I. AYER, Boston, Mass., has been appointed by President Blood, of the National Electric Light Association, to report on the progress of electric heating, at the next convention of the association, to be held in May or June of next year.

MR. W. H. BLOOD, JR., president of the National Electric Light Association, paid a visit to New York last week on association business. Mr. Blood has appointed as a committee on public policy the following gentlemen: Arthur Williams, New York city, chairman; Samuel Scovil, Cleveland, Ohio; Ernest H. Davis, Williamsport, Pa., and Guy E. Tripp, Dallas, Tex.

MR. EDWARD M'DONNELL has been appointed manager of the East Liverpool Traction and Lighting Company, which has taken charge of the United Power Company and the East Liverpool & Wellsville Electric Railway Company, East Liverpool, Ohio. It is announced that the Rock Springs Park property and the East Liverpool & Rock Springs Railway Company will shortly be taken over by the new company.

MR. HERBERT LAWS WEBB has preserved in pamphlet form the *Journal of the Society of Arts* containing the Cantor lectures on telephony, delivered before the society in London, March 13, 20 and 27 and April 3, 1905. In these lectures Mr. Webb took up first an historical study of telephone instruments, the evolution of the transmitter, signal appliances, circuits of telephone sets, telephone lines, telephone cables, distribution, telephone exchanges, telephone buildings, automatic exchanges, tariffs and developments.

NEW INCORPORATIONS.

TOPEKA, KAN.—Chapman Milling, Elevator and Electric Light Company. $30,000.

ST. LOUIS, MO.—St. Louis, Fern Ridge & Western Railway Company, St. Louis. $40,000. Incorporators: S. S. Senne, A. H. Werremeyer, Jacob Studt, William F. Pfister, H. H. Heckmann, John B. Hezel, Eugene Scheble, Richard H. Stephens and John D. Pfister.

GUTHRIE, OKLA.—The Stockmen's Telephone Company, of Canadian, Tex. For the purpose of constructing a telephone line from Canadian, in Hemphill County, to Ochiltree, in Ochiltree County, passing through Lipscomb, in Lipscomb County, and thence to Lockwood, in Beaver County, Okla. $2,500. Incorporators: George Gerlach and D. J. Young, of Canadian, Tex.; W. H. Black and Tom Connell, of Lipscomb, Tex.; A. M. Jines, of Jines, Tex.

ENGINEERING SOCIETIES.

AMERICAN ELECTROCHEMICAL SOCIETY—At a meeting of the board of directors of the American Electrochemical Society held October 7, the following applicants were elected to membership: Frank F. Colcord, Maurer, N. J.; William F. Oesterle, Waukegan, Ill.; Coleman Evan Mutter, Topeka, Kan.; John Meyer, Philadelphia, Pa.; Dr. Frank K. Cameron, Washington, D. C.

THE ELECTRICAL ENGINEERING SOCIETY OF THE PENNSYLVANIA STATE COLLEGE—The Electrical Engineering Society of the Pennsylvania State College met on Wednesday evening, October 25. Articles from the technical press on the subject of automatic block signals were presented by D. A. Barnett and M. L. Roper. Following this presentation there was a general discussion of the subject by various members present.

NEW PUBLICATION.

SMITHSONIAN INSTITUTION—The annual report of the Smithsonian Institution, Washington, D. C., for the year 1904 has just been issued. This is a volume of 800 pages, and contains, in addition to the reports relating to the conduct of the institution, a general appendix in which there are reprinted about sixty important scientific papers published during the year. Those of particular interest to electrical engineers are the following: "A Lightning Spiral Observed Near Basel," by Dr. Klingelfuss; "Some New Methods of Lighting," by A. Berthier; "The Progress in Wireless Telegraphy," by William Maver, Jr.; "Electric Welding Development," by Elihu Thomson; "Rapid Transit Subways in Metropolitan Cities," by Milo R. Maltbie; "The Projected New Barge Canal of the State of New York," by Colonel Thomas W. Symons, U. S. A.

ELECTRICAL SECURITIES.

Despite considerable irregularity in the price of securities during the past week, there was a large volume of business done, and for two days record selling prevailed. While, in some quarters, this has been held as largely professional, it strengthened, to a considerable degree, the hopeful feeling for a holiday boom. At the beginning of the week prices were very generally higher in consequence of the sharp buying movement which was inaugurated just prior to the close of last week's session. The strength of the industrial stocks, particularly those of various railway companies, was based upon the large volume of business that these companies are now doing. It is extremely likely that there will be a continuance for the next six months, at least, of this state of affairs. The threatened civil strife in Russia has made the foreign markets a little apprehensive, but notwithstanding this there has been a monetary ease which has helped conditions in this country materially. The estimated total cotton available, the prices prevailing both in this country and abroad, and the fine condition of the cereal crop, help along the feeling that the early part of the new year will see a very prosperous season.

ELECTRICAL SECURITIES FOR THE WEEK ENDING OCTOBER 28.

New York:	*Closing.*
Brooklyn Rapid Transit	74½
Consolidated Gas	182½
General Electric	185
Interborough Rapid Transit	211
Kings County Electric	200
Manhattan Elevated	165½
Metropolitan Street Railway	119
New York & New Jersey Telephone	169
Westinghouse Manufacturing Company	197

The stockholders of the New York & New Jersey Telephone Company have authorized the increase of the capital stock of the company from $15,000,000 to $50,000,000.

The general balance-sheet of the New York City Railway Company shows assets of $31,686,460, and liabilities of $30,442,964, leaving a surplus of $1,243,496.

The general balance-sheet of the Metropolitan Street Railway shows assets of $100,721,067, and liabilities of $96,814,668, leaving a surplus of $3,906,399.

Boston:	*Closing.*
American Telephone and Telegraph	137½
Edison Electric Illuminating	249
Massachusetts Electric	56
New England Telephone	137½
Western Telephone and Telegraph preferred	90

Directors of the New England Telephone and Telegraph Company have declared the regular quarterly dividend of 1½ per cent, payable November 15.

Philadelphia:	*Closing.*
Electric Company of America	11
Electric Storage Battery common	82
Electric Storage Battery preferred	82
Philadelphia Electric	8½
Philadelphia Rapid Transit	27½
United Gas Improvement	90½
Chicago:	*Closing.*
Chicago Telephone	134
Chicago Edison Light	164
Metropolitan Elevated preferred	71
National Carbon common	61
National Carbon preferred	116
Union Traction common	11
Union Traction preferred	37

The directors of the National Carbon Company have declared the regular quarterly dividend of 1¾ per cent on the preferred stock, payable November 15. Books close November 4 and open November 16.

NEW INCORPORATIONS.

HARRISBURG, PA.—Malvern Electric Light Company, Malvern. $5,000.

LEON, IOWA—Decatur County Mutual Telephone Company. $10,000.

MADISON, WIS.—Belleville Telephone Company. Increased to $10,000.

ALBANY, N. Y.—Sterling Electric Company. Increased from $50,000 to $100,000.

ST. LOUIS, MO.—Gopher State Telephone Company, Beardsley. Increased to $50,000.

AUSTIN, TEX.—Commerce Telephone Company, of Commerce. Increased to $10,000.

ST. PAUL, MINN.—New Ulm Rural Telephone Company. increased to $100,000.

LONE OAK, TEX.—Citizens' Telephone Company. Increased from $8,000 to $16,000.

INDIANAPOLIS, IND.—Steuben County Electric Telephone Company. Increased to $100,000.

COLUMBUS, OHIO—Wood County Telephone Company. Increased from $200,000 to $300,000.

COLUMBUS, OHIO—Lima Electric Railway and Light Company. Increased from $850,000 to $1,250,000.

MILAN, IND.—Milan Telephone Company. $1,000. Directors: James M. Spencer, G. W. Toole and E. H. Shockley.

STREATOR, ILL.—Illinois Light and Traction Company. Incorporators: W. V. Coons, I. H. Sherwood, A. T. Denton.

SPRINGFIELD, ILL.—Grand Telephone Company, El Paso. $2,000. Incorporators: E. P. Armstrong, C. A. Cull, F. I. Jones.

NEW YORK, N. Y.—The Hudson Electric Company. $5,000. Directors: E. W. Moore, F. H. Cowles, and J. N. Shreve, New York.

LITTLE VALLEY, N. Y.—Citizens' Telephone Company. $30,000. Directors: S. W. Wheaton, A. E. Darrow, E. E. Waite, Little Valley.

AUSTIN, TEX.—La Grange & Waldrick Telephone Company, Oldenburg. $1,000. Incorporators: H. Amberg, Louis Voelkel, Charles France and others.

AUSTINBURG, OHIO—Austinburg Telephone Company. $5,000. Incorporators: F. M. Houghlaling, Tracy D. Herrick, G. H. Webb, M. B. Andrews and W. W. Barnes.

HARRISBURG, PA.—Waynesburg Southern Railroad Company. To build twelve miles of road in Greene County. $120,000. President, Thomas F. Barrett, Pittsburg.

LOS ANGELES, CAL.—Valley Electric Company. $500,000. Directors: R. F. Davis, E. A. Miller, and A. Morris, Los Angeles; T. D. Allin and D. Galbraith, Pasadena.

ALBANY, N. Y.—Watkins Consolidated Gas and Electric Light Company, Watkins. $50,000. Directors: M. L. Dreisbach, Easton, Pa.; C. R. Horn and L. E. Varney, New York.

DETROIT, MICH.—Home Telephone Company. $10,000. Incorporators: Max Koehler and Samuel B. Jeffries, of St. Louis, and C. M. Burton and T. A. E. Weadock, of Detroit.

GUTHRIE, OKLA.—The Geary Electric Light and Power Company, of Geary. $5,000. Incorporators: J. J. Paige, Edward Ruggles, J. S. Moffitt, J. S. Morris and Henry Hudson.

AUGUSTA, ME.—Michigan Hydro-Electric Company. To deal in electricity, gas, real estate, etc. $500,000. President, M. B. Wheeler, and treasurer, C. J. Holmes, Grand Rapids, Mich.

LITTLE ROCK, ARK.—Van Buren Electric Light and Power Company. $25,000. Officers: John E. Powers, president; Henry L. Fitzhugh, vice-president; Sidney A. Pernot, secretary and treasurer.

ANDERSON, S. C.—Anderson & Easley Electric Railroad Company. $100,000. Incorporators: R. Frank Smith, of Easley; J. J. Fretwell, of Anderson; J. B. B. Tucker, C. L. Guyton, J. M. Long, J. B. Spearman, A. C. Webb, W. S. Mauldin and L. R. Watson.

TELEPHONE AND TELEGRAPH.

BATH, N. Y.—The Citizens' Telephone Company, a branch of the Interocean, is to expend about $40,000 in building up its business in Bath.

LITTLE ROCK, ARK.—The Reich Telephone Company has closed a contract with the Southwestern Telegraph and Telephone Company for connection as far north as Marshall.

KEWANEE, ILL.—The Stark County Telephone Company re-elected W. R. Sandham and Jehiel Fuller as directors, and elected C. P. Dewey in place of E. S. Buffum, who is in California.

SPRINGFIELD, MASS.—The New England Telephone and Telegraph Company expects to build this fall the conduit to lead its wires to the site of the new building which it will erect next summer.

DEL RIO, TEX.—L. Rust and T. H. Sharp, of San Angelo, have purchased the local telephone exchange of C. W. O'Dell. The consideration was $6,300. Extensive improvements are promised in the near future.

FULTON, N. Y.—The Empire State Telephone Company has filed with the Fulton city clerk a bond of $8,000, the amount which the city has demanded to insure that the telephone company faithfully perform the conditions of the franchise recently granted it to construct a conduit system.

PORTLAND, ORE.—With a force of 380 men the Home Telephone Company is pushing the installation of its automatic system with all possible despatch. It is announced that the company will be in a position to connect subscribers with its three exchanges by next spring. Subscriptions for upward of 5,000 telephones have already been received.

SIOUX CITY, IOWA—The eastern circuit of the New State Telephone Company has been opened. This connects Sioux City with Cherokee, Storm Lake, Sac City, Onawa, Denison and other cities in the central and eastern part of the state. The company will shortly have its toll line completed to Vermillion, Sioux Falls and Yankton. Work on the line, which will extend 150 miles, is completed almost to Vermillion.

WILLIAMSPORT, PA.—A charter has been granted by the state to the Troy & Canton Telegraph and Telephone Company. A. Z. Mason, H. W. Wood, J. H. Preston and W. D. Morse were applicants for the charter. The points to be reached by the line already in operation or hereafter to be built, starting from Troy, are Alva, Canton, Covert, East Troy, West Burlington, Burlington, Franklindale, West Franklin, Leroy, Granville Centre and Granville Summit.

TOLEDO, OHIO—The gross earnings of the Cuyahoga Telephone Company for the six months ended June 30 were $273,375; operating expenses were $143,707; taxes were $9,973; leaving net earnings of $119,695. The fixed charges and deductions were $72,000, leaving a surplus of $47,686 for the half-year period. The company has issued first mortgage five per cent gold bonds to the amount of $2,233,000, more than $500,000 of which were floated in this city last spring by a Toledo syndicate headed by H. R. Ashbrook, Secor Bell and James S. Brailey, Jr.

HOBOKEN, N. J.—The New York & New Jersey Telephone Company has filed plans and specifications for the erection of a new central station building on Madison avenue, Jersey City. The building will be a four-story and basement fireproof structure, will contain all modern appliances, and will cost about $59,000 when completed. The same company has also filed plans for the erection of a three-story and basement fireproof building to be built on the southeast corner of Park avenue and Seventh street, Hoboken. The cost of the building will be $63,000.

PRICE, UTAH—Reuben C. Miller, president and general manager of the Eastern Utah Telephone Company, has completed arrangements with President George Y. Wallace, of the Rocky Mountain Bell company, whereby Carbon County is to have communication with other portions of Utah and adjoining states, the Bell company extending its line from Provo to Price. The Eastern Utah Telephone Company is to erect poles from Price to Colton, and these are to be leased to the Bell people for the stringing of its wires. From Price to Colton there will be a local line maintained by the Eastern Utah company.

ELECTRIC RAILWAYS.

MEMPHIS, TENN.—The Montgomery Street Railway Company has secured property south of its present car barn and will build an addition at a cost of $50,000.

DENVER, COL.—Extensions and improvements on the Denver lines to cost approximately one million dollars are under serious consideration by the Denver City Tramway Company.

SALT LAKE CITY, UTAH—Work on the interurban railroad line, to be constructed from Boise to Caldwell, by the Boise Valley Railway Company, Limited, Donaldson and Ustick, chief promoters, has been begun.

ALBANY, N. Y.—The control of the Troy & New England Railway, running from Albia to Averill Park, has been sold by the Troy stockholders to outside parties. The bonds were sold at ninety cents, while $10 per share was received for the stock.

VINCENNES, IND.—The officials of the Vincennes, West Baden & Louisville Traction Company, Vincennes, have awarded the contract for the construction of the road and the erection of a powerhouse to Louis Metesser, of New Orleans. The road will cost $3,000,000.

WILLIMANTIC, CT.—The Willimantic Traction Company has sold out to the Consolidated Railway Company. The price is not stated. The line was opened about two years ago, and extends to Baltic, a distance of about ten miles. It is believed the line will be extended to South Coventry at an early date.

NIAGARA FALLS, ONT.—An agreement between the Toronto & Hamilton Railway, of Niagara Falls, Ont., and the Electrical Development Company, has been ratified, whereby the former concern will build a railroad between Niagara Falls, Ont., and Toronto. The details of the deal have not yet been made public.

SYRACUSE, N. Y.—The directors of the Rochester, Syracuse & Eastern Railroad have elected the following officers: president, Lyman C. Smith; vice-presidents, F. W. Roebling, of Trenton, N. J., Willis A. Holden and Clifford D. Beebe; treasurer, Albert K. Hiscock; secretary, C. A. Lux; general manager, C. D. Beebe.

ENID, OKLA.—The Enid city council has granted a street railway franchise to Daniel S. Roberts, of Baltimore. The system will cost at least $250,000. The contract calls for the construction of four miles within one year and six miles within eighteen months. It is also proposed to connect the neighboring towns with interurban lines. Wiring is to begin soon.

EAU CLAIRE, WIS.—An Eau Claire syndicate has bought the controlling stock of the Chippewa Valley Electric Railway Company from President Appleyard, of Boston, consideration unknown. The purchase includes the electric railway and light and power plant. O. H. Ingram, of Eau Claire, was elected president. The properties are said to be worth $700,000.

BIRMINGHAM, ALA.—J. M. Dewberry and associates of Birmingham, have been granted a franchise by Tuscaloosa's city council to operate an electric car line in Tuscaloosa County. Similar franchises have been accorded in Jefferson County. Dewberry and associates propose to operate an electric line for conveying freight from Birmingham district to the Warrior river.

NEW YORK, N. Y.—The New York, New Haven & Hartford Railroad Company, which owns the Port Chester trolley lines, has filed a certificate of extension in the county clerk's office at White Plains, which is the first step toward the construction of its double-track road between White Plains and Port Chester. The road will run mainly through private lands acquired by the company.

IRWIN, PA.—Work on the Irwin-Trafford City extension of the Pittsburg, McKeesport & Youghiogheny trolley line is being pushed so as to have the road ready before winter sets in. Of the nine steel bridges on the extension, covering less than six miles, three at Cavittsville have now been completed. When this portion is finished the company will have a straight line from Uniontown to Pittsburg.

BRILLION, WIS.—O. C. Behnke, who is interested in the Fox River Valley Electric Railway, reports that all obstacles are removed and that the construction of the line at an early date is assured. The line, sixty miles long, the longest continuous run of any electric line in the state, will parallel the tracks of the Ashland division of the Northwestern nearly the entire distance from Sheboygan to Kaukauna, passing through Manitowoc and the villages of Newton, Cleveland, Cato, Reedsville and Brillion.

ELECTRIC LIGHTING.

WILKESBARRE, PA.—Plains residents are considering the formation of a company to furnish electric lights for Plains and Miner's Mills.

MONTPELIER, VT.—The capacity of the Bolton Falls plant of the Consolidated Light and Power Company is to be doubled next spring. The present capacity is 2,000 horse-power.

BOSTON, MASS.—Stone & Webster report that a semi-annual dividend of $4 per share has been declared payable on the capital stock of the Lowell Electric Light Corporation November 1, 1905.

WASHINGTON, N. J.—The authorities of Newton have entered into a ten-year contract with the Newton Gas and Electric Company to furnish arc lights for $72.50 per lamp per year, and incandescents for $24.

OSWEGO, N. Y.—Skenandoah mills property on the Oswego canal has been leased for a term of ninety-nine years to a company that is to use the power for generating electricity for mechanical purposes.

OAKDALE, KY.—The American Electric Lighting Company, a concern recently incorporated, has secured a contract from the board of trustees of Oakdale to furnish lights for that suburb for a term of five years.

DENVER, COL.—At a meeting of the board of aldermen ordinances were passed making additions to the lighting of Denver. Over 100 arc lights and nearly 400 fifty-candle-power incandescents will be put in this winter.

MANHEIM, PA.—Manheim borough has given a five-year contract for lighting the borough to the Manheim Electric Light and Heat Company at $11.50 per light per year. This is $2.50 per light less than the old contract, and will save the borough about $200 a year.

QUINCY, ILL.—The Quincy Gas, Electric and Heating Company, at its annual meeting, elected A. L. Stevens, of Detroit, Mich., president; J. T. Lynn, F. K. Pelton, M. G. Borgman, all of Detroit, respectively, vice-president, secretary and treasurer. The officers and Dr. J. H. Rock, of Detroit, and W. A. Bixby and Dr. J. H. Rice, of Quincy, were elected directors.

PHILADELPHIA, PA.—Work on the power plant, near McCall's Ferry, will be begun within sixty days. The Hillside Water and Power Company and the Susquehanna Water and Power Company have been merged into the McCall's Ferry Power Company. The company has purchased lands contiguous to the river for eight miles on both sides of the stream.

LARAMIE, WYO.—The electric light difficulty in Laramie has been finally adjusted by the purchase of the old plant by the new company, which is represented by W. C. Sterne, of Littleton, Col. The agreement to purchase the plant was reached at a meeting held at Littleton. The purchase price is to be the sum of $40,000 as a first mortgage on the plant.

CHARLES CITY, IOWA—A deal has been consummated whereby the electric light company passes from the control of H. V. Fussell & Company to F. O. Martin and A. L. Dodd. The last two mentioned recently purchased the water power at Floyd, and will use the same to furnish power for the light plant of Charles City, transmitting the electricity some six miles. It is said the new company will also make extended improvements.

ROCHESTER, N. Y.—The stockholders of the Wayne County Electric Company, at their annual meeting, elected as directors: Charles D. Beebe, George Dunn, H. H. Crowell, Charles A. Lux, Dr. James W. Putnam, Dwight P. Chamberlain. The directors organized immediately after the stockholders' meeting, electing as officers: president, Dwight P. Chamberlain; vice-president, Charles A. Lux; secretary, Benton S. Rude; treasurer, William H. Akenhead.

BUFFALO, N. Y.—At a meeting of the stockholders of the Niagara, Lockport & Ontario Power Company at Lockport the following new board of directors was elected: Harry H. Westinghouse, George C. Smith, Robert E. Drake, of Syracuse; Paul P. Brady, of New York; J. J. Albright, S. M. Clement, of Buffalo; Carl A. Degersdorff, of New York; William H. Gratwick, of Buffalo, and Edmund Hayes, of Buffalo. The last five take the place of I. H. Babcock, William Richmond, the Hon. Charles Hickey and William Higgs, of Lockport, and P. F. King, of Niagara Falls.

INDUSTRIAL ITEMS.

THE BILLINGS & SPENCER COMPANY, Hartford, Ct., has prepared a new list describing and illustrating "Packer" ratchet drills.

THE AMERICAN ELECTRIC MANUFACTURING COMPANY, Philadelphia, Pa., has moved its office to 931 Chestnut street. Mr. J. Price is the manager of this company.

THE EMERSON ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., will be pleased to send its series of new bulletins descriptive of laboratory lathes, electric volume blowers, bipolar enclosed motors and electric forge blowers.

THE CUTTER COMPANY, Philadelphia, Pa., has reproduced its famous postage-stamp advertisement in blotter form. The blotter is not only serviceable, but attractive. It is so arranged that by loosening up the four binders a new surface can be presented for further wear.

THE WELLMAN-SEAVER-MORGAN COMPANY, Cleveland, Ohio, is distributing a new bulletin descriptive of ladle overhead traveling gantry and locomotive cranes. A number of fine illustrations supplement the text. The book is handsomely printed and is worthy of a careful reading.

THE MACON-EVANS VARNISH COMPANY, Pittsburg, Pa., manufacturer of insulating materials and varnishes, is increasing its manufacturing facilities to take care of the constantly improving trade for its compounds. The company expects, in the near future, to have branch houses in New York, London, Hamburg and Paris.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, Rochester, N. Y., has prepared a handsome booklet descriptive of Stromberg-Carlson cable. This booklet details the making of telephone cable. The matter is interesting and instructive, and is well worthy of perusal by any one concerned in this direction.

THE MANHATTAN ELECTRICAL SUPPLY COMPANY, 32 Cortlandt street, New York city, has issued a pocket catalogue listing and describing, as well as illustrating, telephones, telegraph instruments, burglar-alarms, electric bells, electric motors, electric railways, medical apparatus, flashlights, electric alarm-clocks and numerous other electrical specialties and supplies.

THE AMERICAN ELECTRICAL HEATER COMPANY, New York city, will remove its offices in the near future to 7-9 Warren street, just off Broadway. This move is necessitated because of the fact that the building, which this company now occupies, will be destroyed to make room for a larger one. This office is in personal charge of the president of the company, Mr. B. H. Scranton.

THE STANDARD VITRIFIED CONDUIT COMPANY, whose office is at 39 Cortlandt street, New York, will be among the exhibitors at the electrical show to be held in Madison Square Garden from December 12 to 23. In view of the extensive operations of this company in telephone, railway and electric light underground conduit construction in the East a practical exploitation of its work will be of special value to those interested.

THE FORT WAYNE ELECTRIC WORKS, Fort Wayne, Ind., announces the removal of its Boston office, under the management of Mr. J. Allan Smith, from its old home in 518 Exchange Building, to more commodious quarters at 110 State street, room 601-604 Plymouth Building. The old telephone number—Main 2044—is still retained. This change was necessitated by the large increase in business at this office, and the desire to handle it advantageously.

THE WARREN ELECTRIC MANUFACTURING COMPANY, Warren, Ohio, has been placed in the hands of a receiver, and Mr. H. W. Parsons, cashier of the American Banking Company, has been appointed, giving bonds for $25,000. The action for the appointment of a receiver was taken by Martin A. Warren and D. J. Mackey, executors of the will of the late C. C. Warren. The action is taken to preserve the property, the company having a large government and other contracts on hand.

THE NATIONAL CABLE AND WIRE COMPANY, Pittsburg, Pa., has admitted insolvency, and J. H. Hunter has been appointed receiver. The Common Pleas Court granted a preliminary injunction restraining the company from in any way disposing of or encumbering the assets, or encumbering these assets for the benefit of any particular creditor. Mr. T. Lee Clark, formerly cashier of the Enterprise National Bank, of Allegheny, Pa., who died suddenly last week, was president of the National company.

THE GREEN ENGINEERING COMPANY, Western Union Building, Chicago, Ill., has recently closed a contract for forty Green travel link grates to equip forty 500-horse-power Edgemoor water-tube boilers for the Union Electric Light and Power Company, St. Louis, Mo. The contract was given to the company after a test extending over about six months. The company has also been awarded a contract by the American Steel and Wire Company for 500 horse-power of travel link grates for the Consolidated plant at Cleveland, Ohio.

THE CHICAGO PNEUMATIC TOOL COMPANY, Chicago, Ill., announces the quarterly report of the president to the shareholders. The profits for the third quarter were $241,791.45, less depreciation of buildings, plant and machinery, including repairs and renewals of buildings and plant, and amount written off for experimenting and perfecting new lines of tools of $32,488.29, leaving a total of $209,303.16. After deducting bond interest for the quarter, sinking fund reserve and the quarterly dividend No. 11, there is a balance carried to surplus of $106,915.33. The total surplus carried forward is $483,813.50.

THE NATIONAL-ACME MANUFACTURING COMPANY, Cleveland, Ohio, is preparing plans and will commence building operations at once on a four-story-and-basement brick and steel addition to its present plant. It is hoped to have the building ready for occupancy early in 1906. A four-story addition was built during the past summer, but this afforded only a temporary relief to the crowded condition of all departments. The company builds the "Acme Automatic" multiple spindle screw machine. The company maintains branch offices in New York, Boston and Chicago, and is represented in Europe by Messrs. Schuchardt & Schutte.

THE ALLIS-CHALMERS COMPANY, Milwaukee, Wis., has closed a contract with the Yampa Smelting Company for six McDougall furnaces, to be installed in the Salt Lake City plant. The furnaces are of the standard Klepetke-McDougall type, with all the latest improvements. Each furnace will have six superimposed hearths, each with its sets of rabble arms and rakes. The furnaces are all of the large size, measuring eighteen feet outside diameter. The Nevada Consolidated Copper Company, Lyon County, Nev., has closed a contract with the Allis-Chalmers Company for a battery of six large-sized McDougall roasting furnaces, each with six hearths.

THE NEW PROCESS RAW HIDE COMPANY, Syracuse, N. Y., has announced its intention of going more extensively into the manufacture of metal gears of all kinds, as well as its well-known "New Process" noiseless pinions. The company has completed a two-story brick addition containing about 10,000 square feet of floor space, and is installing a number of additional turret lathes, drills, grinders, spur gear cutters, bevel gear planers, and other machines necessary for the manufacture of accurate gearing. This additional equipment will increase the company's capacity about seventy-five per cent. Business is reported very brisk, and the shipments are considerably in excess of last year, with very bright prospects for a continuation of this condition.

BAKER & COMPANY, INCORPORATED, Newark, N. J., refiner and manufacturer of platinum, gold and silver, has been awarded a gold medal for the excellency and variety of its exhibit at the Lewis and Clark Centennial Exposition, just closed at Portland, Ore. This was the first exhibit of its character on the Pacific coast, and was located in the Mines and Metallurgy Building, under government supervision. The exhibit attracted the special attention of a large number of visiting miners and metallurgists who, in recent years, have been devoting greater care to the recovery of platinum known to exist in the alluvial deposits along the Pacific coast. The company's exhibit was comprehensive in its character, including numerous samples of crude platinum ore, the salts and solutions of the metal, and various forms of platinum ware such as are used daily in the arts and industries. A more extensive exhibit which the company displayed at the Louisiana Purchase Exhibition in 1904 was awarded the grand prize.